

Easy to build projects for everyone

F\$128 N.82
70p

Everyday **ELECTRONICS**

**AUTOMATIC
GARAGE DOOR**



MODEL TRAIN CHUFFER

REGULATED POWER SUPPLY

MINI EGG TIMER

LONDON'S
TEST EQUIPMENT
CENTRES

AUDIO ELECTRONICS

Retail • Mail Order • Industrial • Educational • Export

OPEN SIX DAYS A WEEK • CALL IN AND SEE FOR YOURSELF

ALL MODELS
ON DISPLAY
ALL PRICES INCLUDE VAT

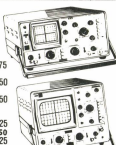
CRANGE OSCILLOSCOPES

Range of Portable Scopes mains and battery operated.

Special features (UK c/p £3.00).

- 3030 Single trace 15 MHz, 5 mV, 0.5 micro secs. Plus built in component tester, 95mm tube **£166.75**
3131 Dual trace 15 MHz, trig to 35 MHz, 5 mV, 0.5 micro sec, 130mm tube, plus component tester **£264.50**
3034 Battery-mains dual trace 15 MHz, trig to 20 MHz, built in Nicads, 5 mV, 0.5 micro secs (Eliminator charger optional £28.75) **£365.50**

Also Available 3337, single trace 3034 Model 3035 was **£189.75**, Special Offer **£168.50**
STOP PRESS 3337, dual 30 MHz, 150mm **£408.25**



RF AND AUDIO SIGNAL GENERATORS

Mains operated (UK c/p £1.00)

- Audio 100 KHz-200 KHz 4 band Sine/Square c/p **£63.00**
TE220 Distortion max 1% **£63.00**
LAG28 Distortion 0.5% 1% leader **£73.70**
AG228 Distortion 0.5-1% Trio **£78.20**
AG203 10 MHz 15 Hz band max distortion 0.1% Trio **£126.50**
RF All feature Int/Ext MOD Variable output **£52.00**
TE200 100 KHz-100 MHz 6 band (300 MHz harmonics) **£52.00**
LS616 100 KHz-100 MHz 6 band (300 MHz harmonics) Leader **£52.00**
SG402 100 KHz-30 MHz 6 band professional Trio **£58.00**



SABTRONICS EQUIPMENT

New reliable range of DMM's and frequency computers with those extra facilities and competitive prices. All battery operated (supplied). Except 5020A mains. Optional mains eliminators available.

9 DIGIT COUNTERS 0.1 Hz to 10 MHz res. 10mV sensitivity to 100 MHz.

(UK c/p £1.00)

8110A 20 Hz-100 MHz in 2 ranges **£77.00**

8610A 20 Hz-600 MHz in 3 ranges **£94.00**

9 DIGIT COUNTERS 30mV sensitivity to 10 MHz. Resolution 0.1 Hz to 10 MHz **£114.00**

8610B 10 Hz-100 MHz in 3 ranges **£178.00**

8000B 10 Hz-100 MHz in 3 ranges **£178.00**

FUNCTION GENERATOR (UK c/p £1.00) with mains adaptor

5020A 1 Hz-200 KHz Sine/Square/Triangle/TCF Freq sweep Low distortion **£90.00**

DIGITAL MULTIMETERS Two LCD hand held - one with temperature range. Also LCD and LED Bench models 0-1% Basic accuracy

2033A 3 1/2 digit LCD hand 2A AC/DC 20Meg ohm ETC **£71.00**

2037A As 2033A with -50°C to +20°C Temp. range 0.1° resolution **£77.00**

3 1/2 digit LED. Auto decimal & minus. 10A AC/DC. 20Meg ohm etc **£81.00**

2015A LCD version of above **£95.00**

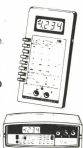
c/p 2035/27A 65p. All others £1.00 **£1.00**

POWER SUPPLIES 13.8 volt. Output regulated mains operated (c/p £1.00)

3 to 5 amp **£13.95**

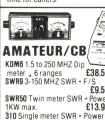
5 to 8 amp **£17.95**

NEW LOW PRICES



ALSO STOCKED

Further range of low cost equipment Plus tools, accessories etc. Also special offers which vary from time to time for callers.



AMATEUR/CB

KOM6 1.5 to 250 MHz Dip meter, 6 ranges **£38.50**

SWR30 150 MHz SWR + F1.5 **£50.50**

SWR50 20mW meter SWR + Power 10W max **£13.95**

30 Single meter SWR + Power 10W **£8.95**

100W SWR/Power/F1.5/100W **£11.95**

171 As 170 10mW meter **£14.50**

175 SWR/F1.5/AE Match 40 (40MHz) **£13.80**

176 As 175 - 0/5/50 Watt power **£16.95**

178 As 175 - 0/10/100W + MOD Scale **£19.50**

HW35 SWR meter Plus 2K Volt 19 range Multimeter **£28.95**

(Note: SWR-Power ETC to 144V)

Just a selection of a huge range in stock - send for latest lists including professional ranges.

VARIABLE REGULATED POWER SUPPLIES

Mains operated regulated single meter (UK c/p £1.50)

241 0/12/0/24V 1 amp **£35.00**

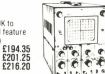
154 5-15 volt 3 amp **£44.00**

154 5-15/0/24V 3 amp **£40.00**

£194.35

£201.25

£216.20



THANDAR - SINCLAIR

Reliable low cost portable instruments, bench models all 25 x 15 x 5 cm. Generators mains operated rest battery (supplied). UK c/p Hand models 65p. bench £1.15

DIGITAL MULTIMETERS (3 1/2 digit) LCD **£47.50**

TM354 Hand held, DC 2A, 2m ohm, 1mV - 1000V DC, 500V AC **£54.94**

TM352 Hand held, DC 10A, Hfe test, Continuity test **£86.25**

TM353 Bench, 2A AC/DC, 1000V AC/DC, 20M ohm **£113.85**

Typical 0.25% New low price

Typical 0.1% 10A AC/DC, 1000V AC/DC, 20M ohm

FREQUENCY COUNTERS (8 digit)

PFM200 A hand held LED 200 MHz, 10mV, 600 Hz with TP600 New model fitted 6 P.A.C. sockets. **£166.75**

TF600 Bench LCD, 40 MHz, 40mV, 400 MHz with TP600 **£43.13**

TF200 Bench LCD, 20 MHz, 10-30mV, 600 Hz with TP600 **£166.75**

TP600 600 MHz, 10 Prescaler 10 mV **£43.13**

GENERATORS (All bench models) mains operated

TF100 Function 1 Hz-100 KHz Sine/SQ/Triangle/TTL **£90.85**

TF102 Function 0.2 Hz-2 MHz Sine/SQ/Triangle/TTL **£166.75**

TF105 Pulse 5 MHz-5 kHz 200mV-200mV various outputs **£57.75**

OSCILLOSCOPE (Bench model low power portable)

10 MHz 2" trace, 10mV, 0.1 micro sec. All facilities **£159.85**

Model SC110

(Rechargeable battery pack **£8.63**, AC adaptor/charger **£5.69**)

OPTIONAL TESTS

Carry case (bench only) **£6.84** AC Adaptors (state model) **£5.69**



LCD DIGITAL MULTIMETERS

SPECIAL PURCHASE - LIMITED PERIOD ONLY

8220 Reliable 22 range hand held 3 1/2 digit LCD with volt/ohms auto range, unit and range signs, 10 amp AC/DC, battery warning, lower power ohms range. Model 8220 also has range held, continuity buzzer and improved accuracy. All models high quality ready for operation. Resolution 0.1 milli-volt, 10 Micro amp, 0.1 ohm.

8220 1000V DC, 0.2/10A AC/DC, 600V AC, 2meg ohm. Was **£55.95**

NOW £42.95

6110 As above plus 20mA AC/DC and improved accuracy. Was **£85.95**

NOW £59.95

THIS SPECIAL OFFER IS QUALITY WITH VALUE

Also in stock.

D0401 12 range push button 2A AC/DC **£39.95**

188m 16 range with Hfe checker 10 amp DC **£43.50**

189m 16 range with Hfe checker 10 amp AC/DC **£69.95**

MULTIMETERS

(UK c/p 65p or £1.00 for two)

CHOOSE FROM UK'S LARGEST RANGE

KRT101 10 range pocket 1K Volt **£4.50**

KRT100 12 range pocket 1K Volt **£5.80**

NHSS 10 range pocket 2K Volt **£5.80**

AT1 12 range pocket Deluxe 2K Volt **£7.75**

S15 11 range pocket 4K Volt **£8.50**

NHSS 22 range pocket 4K Volt **£11.50**

YN360TR 19 range plus Hfe Test 20K Volt **£13.50**

3730TR 19 range plus Hfe Test 20K Volt **£15.95**

KRT500 16 range - range double 50K Volt **£16.50**

AT1020 19 range Deluxe plus Hfe Test 20K Volt **£16.95**

ETC5000 As KRT5001 plus colour scales 50K Volt **£17.95**

T08118 range - range double 10A DC/50K Volt **£20.85**

TM4500 23 range - Plus 12A DC Plus Cont. Buzzer 30K Volt **£22.75**

AT205 21 range Deluxe 10A DC 50K Volt **£25.75**

C7080 26 range large scale 10A DC, 5KV AC, 50K Volt **£27.50**

160m 36 range large scale 10A AC/DC **£28.50**

AT7210 23 range Deluxe 12A AC/DC 100K Volt **£30.50**

360TR 23 range Large scale 10A AC/DC Hfe Test 50K Volt **£34.95**

10mV AC/DC, 100K Volt **£34.95**



LOGIC PROBES/MONITORS/PULSERS circuit

powered (UK c/p 60p)

LP1 DTL/TTL/CMOS, 10 MHz, Pulse Memory **£35.50**

LP2 DTL/TTL/CMOS, 15 MHz, Pulse Memory **£18.95**

LP3 DTL/TTL/CMOS, 50 MHz, Pulse Memory **£55.95**

LM1 Logic monitor for 8 to 16 pin IC's **£33.00**

OP1 Digital pulser, Single or 100pps **£58.50**

LP07B 50 MHz, 10Meg ohm, Logic Probe, with case **£56.90**

ALL PRICES INCLUDE VAT

DIRECT READ HV PROBE

(UK c/p 65p)

0/40KV, 20K Volt **£18.40**

DISCOUNTS

Available for UK and Export for small and large quantities. Please enquire.

OSCILLOSCOPE

PROBE KITS (UK c/p 50p)

per 1 to 31 Available BNC plug or Banana X147 **95 X10**

£9.45 As 1X10X10, 50 Ohm

X100 (BNC only) **£16.95**

FREE CATALOGUE!

Send large SAE (20p UK)

Schools, Companies, etc. free on request.

SAGFAN PORTABLE OSCILLOSCOPES

Range of low cost Dual Trace Scopes mains operated. Made in UK to exacting standards. Available as 10 MHz, 15 MHz or 20 MHz. All feature 5mV sensitivity, 0.5 micro sec, 6.4 x 8cm display. (UK c/p £2.50)

07410 Dual 10 MHz **£194.35**

07415 Dual 15 MHz **£201.25**

07420 Dual 20 MHz **£216.20**



AUDIO ELECTRONICS

301 EDGWARE ROAD, LONDON, W2 1BN, ENGLAND. TELEPHONE 01-724 3564

ALSO AT HENRY'S RADIO, 404/406 EDGWARE ROAD, LONDON W2

OPEN SIX DAYS A WEEK • CALL IN AND SEE FOR YOURSELF

Order by Post with CHEQUES/ACCESS/VISA or Telephone your order



Cubagate Limited

Everyday ELECTRONICS

VOL. 11 NO. 1 JANUARY 1982

PROJECTS ... THEORY ... NEWS ...
COMMENT ... POPULAR FEATURES ...



© IPC Magazines Limited 1982. Copyright in all drawings, photographs and articles published in **EVERYDAY ELECTRONICS** is fully protected, and reproduction or imitations in whole or in part are expressly forbidden.

Our February issue will be published on Friday, January 15. See page 43 for details.

PROJECTS

- AUTOMATIC GARAGE DOOR** by P. Horsey 12
Part 1: The ultrasonic transmitter and receiver
- MODEL TRAIN CHUFFER** by R. A. Penfold 18
Realistic sound effect for "steam" locomotives
- SIMPLE STABILISED POWER SUPPLY** by F. G. Rayer 31
Variable output up to 18 volts 1 amp
- MINI EGG TIMER** by D. G. Clarke 44
A pocket-sized bleeper with presettable timing
- SIREN MODULE** by A. R. Winstanley 46
Multi-purpose audible alarm

SERIES

- TEACH-IN 82** by O. N. Bishop 22
Part 4: Switching circuits using transistors and i.c.s
- INTRODUCTION TO LOGIC** by J. Crowther 36
Part 9: Boolean Identities

FEATURES

- EDITORIAL** 11
Information Year
- JACK PLUG AND FAMILY** by Doug Baker 21
Cartoon
- SHOP TALK** by Dave Barrington 30
Product news and component buying
- COUNTER INTELLIGENCE** by Paul Young 33
A retailer comments
- FOR YOUR ENTERTAINMENT** by Barry Fox 34
Changes at the Post Office, more Freedom for Phone Subscribers
- SCHOOLS COMPETITION** 35
Closing date for Registration is December 31
- EVERYDAY NEWS** 38
What's happening in the world of electronics
- VOYAGER 2 ENCOUNTERS SATURN** by J. B. Dance 40
An account of data and pictures received from space
- RADIO WORLD** by Pat Hawker G3VA 42
Narrow band F.M. and S.S.B., C.B. Licences, Brass Pounders
- ELECTROPLATING** by R. M. Henderson 50
A technique for non-conducting objects
- BRIGHT IDEAS** 51
Readers' hints and tips
- SQUARE ONE** 52
Beginners' Page: Transistor data and outlines
- NEW PRODUCTS** 54
Facts and photos of instruments, equipments and tools
- IN MY CLASS** by T. R. de Vaux-Balbirnie 57
Sir explains
- CIRCUIT EXCHANGE** 58
A forum for readers' ideas

Readers Services • Editorial and Advertisement Departments

11

ELECTRONI-KIT

DENSHI KITS—

Final offer on kit type SR-3A



"... fun and entertainment
as well as education" —

(EVERYDAY ELECTRONICS mag.)

This is the final opportunity to obtain this first-class multi-project kit at little more than its 1977 price! (Current value over £40).

Circuits are constructed by plugging the encapsulated components into the boards provided, following the instruction manual. Technical details are also given concerning each project. The components are used over and over again and you can design your own circuits too, or use the kit as a useful testing board. No previous experience of electronics is required but you learn as you build—and have a lot of fun too. The kits are safe for anyone.

SR-3A KIT (16½" 10" 2½") £29.95

Build over 100 projects including 3-TR reflex radio receiver, 3-TR radio receiver with RF amplifier, 3-TR reflex radio receiver, 3-TR amplifier for crystal mks, 3-TR amplifier for speaker/mike, 3-TR signal tracer, Morse Code trainer, 2-TR electronic organ, electronic metronome, electronic bird, electronic cat, electronic siren, electronic gun, 2-TR sleeping aid, high voltage generator, discontinuity warning device, water supply warning device, photoelectric alarm device, 3-TR burglar alarm, 3-TR water supply warning device, 3-TR water level warning device, 3-TR photoelectric alarm device, Morse Code trainer with sound & light, discontinuity warning device with sound & light, water level warning device with sound & light, electronic metronome with sound & light, buzzer with sound & light, wireless mike, wireless telegraph set, wireless discontinuity warning device, wireless water level warning device, wireless water supply warning device, wireless photoelectric warning device, etc.

All kits are guaranteed and supplied complete with extensive construction manual **PLUS** Hamlyn's "All Colour" 160 page book "Electronics" (free of charge whilst stocks last).

Prices include educational manual, free book, VAT, p & p (in the UK), free introduction to the British Amateur Electronics Club.

**PLEASE NOTE OUR NEW ADDRESS.
PERSONAL CALLERS WELCOME.**

Delivery frequently by return but please allow 14 DAYS
Cheque/P.O./Access/Barclaycard (or 23p for illustrated
literature) to **ELECTRONI-KIT LTD., Dept. EE.**

**ELECTRONI-KIT LTD.
388 ST. JOHN STREET
LONDON, EC1V 4NN (01-278 0109)**



Just **50p** will bring you the latest Wilmslow Audio
80 page catalogue packed with pictures and specifications
of HiFi and PA Speaker Drive Units, Speaker Kits,
Cabinet Kits

1000 items for the constructor.

**CROSSOVER NETWORKS AND COMPONENTS.
GRILLES, GRILL FABRICS AND FOAM. PA, GROUP
DISCO CABINETS PLUS MICROPHONES —
AMPLIFIERS — MIXERS — COMBOS — EFFECTS —
SPEAKER STANDS AND BRACKETS — IN-CAR
SPEAKERS AND BOOSTERS ETC. ETC.**

★ Lowest prices — Largest stocks ★

★ Expert staff — Sound advice ★

★ Choose your DIY HiFi Speakers in the comfort ★
of our listening lounge.

(Customer operated demonstration facilities)

★ Ample parking ★

★ Access Visa American Express accepted ★



0625 529599

35/39 Church Street, Wilmslow, Cheshire SK9 1AS



Lightning service on telephoned credit card orders!



TECHNICAL TRAINING IN ELECTRONICS AND TELECOMMUNICATIONS

ICS can provide the technical knowledge that is so essential to your success; knowledge that will enable you to take advantage of the many opportunities open to you. Study in your own home, in your own time and at your own pace and if you are studying for an examination ICS guarantee coaching until you are successful.

City and Guilds Certificates:
Telecommunications Technicians
Radio, TV, Electronics Technicians
Technical Communications
Radio Servicing Theory
Radio Amateurs
Electrical Installation Work
MPT Radio Communications Certificate

Diploma Courses:
Colour TV Servicing
Electronic Engineering and Maintenance
Computer Engineering and Programming
Radio, TV, Audio Engineering and Servicing
Electrical Engineering, Installation
and Contracting

POST OR PHONE TODAY FOR FREE BOOKLET

**ICS To: International Correspondence
Schools**

Dept 2680 Intertrust House, London
SW8 4UJ or telephone 622 9911

Subject of Interest
Name
Address
Tel: Age:

ATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER CALLERS WELCOME. Tel. Watford 40588/9

GREENE

443D MILLBROOK ROAD, SOUTHAMPTON SO1 0HX
All prices include VAT—just add 40p post. Tel (0703) 772501
Goods normally despatched by return of post

AMAZING! COMPUTER GAMES PCB'S FOR PEANUTS!!

A bulk purchase of PCB's from several well known computer games including Battleships, Simon, Logic 5 and Starbird enable us to offer them at incredibly low prices:

'STARBIRD'

Gives realistic airborne sounds and flashing red blaster—accelerating engine noise when module is pointed up, decelerating when pointed down. Press a control to see flash and hear blast of lasers shooting. PCB fasted and working. Needs PP3 and 200V TA SCR, only £2.95

'SIMON'

The object of this game is to repeat correctly a longer and longer sequence of signals in 4 different games. (Instructions included) PCB contains chips, switches, lampholders and lamps, and is tested working, complete with speaker. Needs PP3 and 2 x HP11. PCB size 130 x 130mm only £2.95

'COMPUTER BATTLESHIPS'

Probably one of the most popular electronic games on the market. Unfortunately the design makes it impractical to test the PCB as a working model, although it may well function perfectly. Instead we have the sound chip, and sell the board for its component value: SN76477 sound IC, TMS1000 u-processor; batt clips, R's etc. Size 180 x 140mm. Only £3.95. Instruction book and circuit 20p extra.

'LOGIC 5'

The object is to find the number held in the memory with as few entries as possible. PCB contains u-processor chip and 10 tests, and is linked to a membrane type keyboard. Overlay for keys and instruction provided. PCB size: 80 x 80 x 45. 10 tests. Supplied tested and working—PP3 required. Only £2.95

'MICROVISION' Cartridges

These are a small PCB with a micro-processor chip, designed to plug in to the microvision console. Only one is, we don't have any consoles! However, they can be used as an oscillator with a different filter, outputs simply by connecting a battery and speaker. Tested and working (as an osc) with pin out data. PCB size 72 x 60mm, only 25p each

RELAY TRIAC PANEL

Z537 PCB 100 x 75mm containing a wealth of components: 2 x 12V DPDT relays, 2 x 40V 15mA SCRs, 10A 500V triac, C12SD 8A 400V SCR, 955 timer, 10 x 1N4001 diodes, 2N5050 SCR, 2 x 3mm LED's x 2N3704, R's & C's—Amazing value, just bought separately, parts would cost around £80. Our price for the panel, just £6.95

200 ELECTROLYTICS £4.00

K254 Large variety of values/voltages, mostly cropped leads for PCBs, min. 1-1000uf, 10-40V. All new full spec components, not chucked-out! 200 EA, 1000 ETS 50

COMPONENT PACKS

K200 100 wirewound resistors from 1W to 12W, with a good range of values, £1.75.
K205 50 assorted potentiometers, all types including single, ganged, rotary and slider. £1.75.
K311 200 small value poly, mica, ceramic caps from a few pf to 0.22F. Excellent variety. £1.75.
K314 100 silver mica caps from 50pF to a few thousand pf. Tolerances from 1% to 10%. £2.00.
K300 Switch pack—25 different, rocker, slide, rotary, toggle, push, micro, etc. Only £2.00.
K301 Heatshrink pack—5 diff. sizes, each 200mm. £2.00.

1000 RESISTORS £2.50

Not just purchasing another 5 million preformed resistors, and can make a similar offer to that made two years ago, at the same price!! K302—1000 mixed 2 and 3W 5% carbon film resistors, 1000000 for PCB fitting. Economical range of preferred values. Cost of £2.50; 5000 ETS; 20K 35p.

PANELS

Z821 Panel with 16326 (2N4424) on small heat sink, 2N2223 dual transistor, 2 BC108, 2 BC107, 2 BC109, etc. £1.75.
Z827 Reed relay panel—contains 2 x 6V reeds, 5 x 25000 or 25230, 6 x 400V reeds + Rs. 50p.
Z829 Pack of ex-computer panels containing 14 series ICs. Lots of different and complex logic. All ICs are marked with type no. or code for which an identification sheet is supplied. 20 ICs £4.95; 100 ICs £6.95.
A504 Block case 50 x 50 x 76mm with octal base. PCB inside has 24V reed relay, 200V 1A SCR, 4 x 5A 200V reeds, etc. 60p.

TEACH-IN 82

Full set of parts as specified by 'EE'—All new goods, despatched by return of post.
* All parts for the 'MINILAB' only £1.95 + £1 post.

* All components for first 6 parts of 'TEACH-IN SET' £7.99 + 60p post.

BUY BOTH SETS FOR £24 + £21 post!
Deduct £1 if Vero router and/or solder.

FREE catalogue with all orders!!
* Free component identification chart!!
* Free piece of Veroboard!!

CAPACITOR BARGAINS

2200uf 100V cans 75 x 35mm dia. 75p;
10155 90; 2200uf 10V axial 50p; 100 £2.30;
1000 £16; 400-100uf 275V 100 x 44mm dia.
75p; 15 £2.50; 2200uf 50V 100 x 100 x 50uf 300V can 75 x 44mm dia 40p; 10/13;
100 £68 100uf 25V Axial £3/100.

4 TERMINAL REGS

µATM8G In power min-dip case 5-30V at 1A. 75p.
µATM8G Negative version of above. £1.20.

On 4 x 4s components required (50p extra) to make a fully variable supply!! Data supplied.

1W AMP PANELS

A011 Computer amp panel intended for record player on panel 95 x 65mm including 200k pot and switch, complete with knobs. Apart from amp circuitry built around LM380 or TBA2050, there is a tuned circuit circuit using 5 transistors, 5V operation, connection data supplied. Only £1.95.

VU METERS

V006 Very attractive 55 x 45mm scaled -20 to +50dB, 250uA movement. Only £1.75, or £3.95 pair

OP-AMP PSU KIT

A198 All parts + instructions to make a 50mA $\pm$ 15, 0-15V supply from mains input. Only £1.95.

COPPER CLAD BOARD

K322 All pieces too small for our etching kits. Mostly double sided fibreless. 250mm (approx. 110 in line) for just £1.65

JOB LOT OF COMPONENTS

5000 1N4008; 10000 03310; 20000 100F/50V; 15000 22/12; 11000 2200uf 50V 15000 80p; 30000 various resistors. Total 112,500 components for £350 inc. VAT & car.

GAS DISCHARGE DISPLAYS

7 seg displays available in 3 styles. Char. height 12.5mm.
Z829 2 digit on PCB with 16 way ribbon cable terminated in 16 DIL header plug, giving multiplexed output. £1.20
Z831 3 digit as above £1.70
Z832 3 + 2 digit as above £2.50
Data supplied.

MK4027 SHIFT REGISTER

2048 bit dynamic shift register, 6MHz. Ideal for CRT displays, buffer memories etc. Special low price £1 each, 4 for £4.

FILAMENT DISPLAYS

Z853 7 seg display 12.5mm high. Ideal for TTL operation, taking 6V 50mA per seg. Set 14 DIL packages. Only £1 each, 4 for £3.00. Data supplied.

TOROIDAL TRANSFORMER

110V 400VA 400VA 110/240V PL. Sec. 18V 4A, 6.3V 1A, 250V 0.3A. Ideal for scopes, monitors, VDU's, etc. Special low price £7.95.

VEROBLOC BREADBOARD

New from Vero, this versatile aid for building and testing circuits can accommodate any size of IC. Blocks and be joined together. Bus strips on X & Y axis—total 900 connection points for just £4.15. (Photo shows 2 blocks)

SAVE £111
ONLY £2.19
WITH VERO
VOUCHER
(In Oct. issue)



FROM A NEW COMPANY WITH NEW IDEAS

SOMETHING SPECIAL

AIRWAVES ELECTRONICS INVITE YOU TO OPEN YOUR OWN PERSONAL ACCOUNT.

THERE COULDN'T BE AN EASIER WAY TO BUY COMPONENTS, ONCE YOU HAVE OPENED YOUR ACCOUNT, JUST PHONE OR WRITE YOUR ORDER THROUGH, STATING YOUR ACCOUNT NUMBER TOGETHER WITH YOUR OWN SECURITY CODE NUMBER AND GOODS WILL BE DESPATCHED SAME DAY AND YOUR ACCOUNT DEBITED WITH THE COSTS.

MAYBE YOUR THINKING—YOU'LL HAVE TO PAY OVER THE ODDS FOR THIS, BUT YOU WILL BE WRONG, ACCOUNT CUSTOMERS WILL RECEIVE OUR PRODUCT PACKED CATALOGUE SHOWING VAT INCLUSIVE PRICES, WHICH WE BELIEVE TO BE VERY COMPETITIVE. AFTER ALL YOU'RE THE BEST JUDGE AND WE DO OFFER SOMETHING SPECIAL.

IF YOU WOULD LIKE TO OPEN YOUR ACCOUNT, THEN PLEASE CONTACT US FOR APPLICATION DETAILS ENCLOSING JUST A STAMP TO COVER POSTAGE.

CALL AND SEE US AT OUR RETAIL SHOP.

AIRWAVES ELECTRONICS

151 LONDON ROAD, CAMBERLEY, SURREY GU15 3JY. TEL. (0276) 62949

MUSIC TESTS

ALL WITH PRINTED CIRCUIT BOARDS

12-Note Sequencer	SET79 10 45	Drum-Synthriser	SET110 50 11
16-Note Sequencer	SET86 44 63	Enlarger Timer	SET93 39 22
3-Channel Mixer	SET90 21 50	Frequency Doubler	SET98 11 75
3-Microphone Mixer	SET108 12 90	Funny Talker	SET99 16 35
6-Channel Mixer	SET90 96 67	Guitar Effects	SET42 15 82
Analogue Reverb	SET102 16 82	Graphic Equalizer	SET106 15 15
Audio Effects	SET105 12 54	Guitar Overdrive	SET36 21 17
Chorusynth	SET100 125 04	Guitar Sustain	SET75 11 77
Compressor	SET130 15 50	Headphone Amplifier	SET104 21 45
Digital Reverb	SET78 75 50	Melotrone	SET110 16 34
Discoauto	SET57 38 18	Microphone Pre-amp	SET61 11 32

NEW LIST NOW READY!

SEND S.A.E. FOR FREE COPY

Noise Limiter	SET97 15 96	Split-Phase Tremolo	SET102 29 98
F. Minisonic Synth	SET38 18 15	Switched Treble Boost	SET99 12 35
Phaser	SET38 21 08	Synthesizer Interface	SET81 4 49
Phasing & Vibrato	SET10 36 25	Transient Generator	SET83 16 86
Practice Amplifier	SET08 12 15	Tremolo	SET110 15 15
Rhythm Generator	SET 103 See Lists	Tuning Fork	SET46 37 94
Signal Tracer	SET10 15 50	Ultrasonic Fader	SET106 21 45
Simple Phase Unit	SET29 18 54	Video-Scrambler	SET117 21 81
Smooth Fuzz	SET91 15 50	Wah-Wah	SET104 21 45
Speech Processor	SET110 12 18	Wind and Rain Unit	SET28 11 39

Sets include PCBs, U.K. P. & P., 15% VAT, Res., S.C.A., Pots, Knobs, S.W.'s, Sits, Wire, Solder, Box, Photocopy of Orig. Test. Full details and more great kits in our Free Catalogue.

Prices correct at press, E. & O.E., subject to stock. Delivery frequently by return but please allow 14 days.

PHONOSONICS

DEPT EE21, 22 HIGH STREET, SIDCUP, KENT, DA14 6EH
01-302-8184

The Rapido Electronics

Tel: 0322 863494
Hillcroft Road
Station Road
Eynsford Kent DA4 0EJ

TRANSISTORS

AC125	35	BC157	57
BC158	58	BC159	59
BC160	60	BC161	61
BC162	62	BC163	63
BC164	64	BC165	65
BC166	66	BC167	67
BC168	68	BC169	69
BC170	70	BC171	71
BC172	72	BC173	73
BC174	74	BC175	75
BC176	76	BC177	77
BC178	78	BC179	79
BC180	80	BC181	81
BC182	82	BC183	83
BC184	84	BC185	85
BC186	86	BC187	87
BC188	88	BC189	89
BC190	90	BC191	91
BC192	92	BC193	93
BC194	94	BC195	95
BC196	96	BC197	97
BC198	98	BC199	99
BC200	100	BC201	101
BC202	102	BC203	103
BC204	104	BC205	105
BC206	106	BC207	107
BC208	108	BC209	109
BC210	110	BC211	111
BC212	112	BC213	113
BC214	114	BC215	115
BC216	116	BC217	117
BC218	118	BC219	119
BC220	120	BC221	121
BC222	122	BC223	123
BC224	124	BC225	125
BC226	126	BC227	127
BC228	128	BC229	129
BC230	130	BC231	131
BC232	132	BC233	133
BC234	134	BC235	135
BC236	136	BC237	137
BC238	138	BC239	139
BC240	140	BC241	141
BC242	142	BC243	143
BC244	144	BC245	145
BC246	146	BC247	147
BC248	148	BC249	149
BC250	150	BC251	151
BC252	152	BC253	153
BC254	154	BC255	155
BC256	156	BC257	157
BC258	158	BC259	159
BC260	160	BC261	161
BC262	162	BC263	163
BC264	164	BC265	165
BC266	166	BC267	167
BC268	168	BC269	169
BC270	170	BC271	171
BC272	172	BC273	173
BC274	174	BC275	175
BC276	176	BC277	177
BC278	178	BC279	179
BC280	180	BC281	181
BC282	182	BC283	183
BC284	184	BC285	185
BC286	186	BC287	187
BC288	188	BC289	189
BC290	190	BC291	191
BC292	192	BC293	193
BC294	194	BC295	195
BC296	196	BC297	197
BC298	198	BC299	199
BC300	200	BC301	201
BC302	202	BC303	203
BC304	204	BC305	205
BC306	206	BC307	207
BC308	208	BC309	209
BC310	210	BC311	211
BC312	212	BC313	213
BC314	214	BC315	215
BC316	216	BC317	217
BC318	218	BC319	219
BC320	220	BC321	221
BC322	222	BC323	223
BC324	224	BC325	225
BC326	226	BC327	227
BC328	228	BC329	229
BC330	230	BC331	231
BC332	232	BC333	233
BC334	234	BC335	235
BC336	236	BC337	237
BC338	238	BC339	239
BC340	240	BC341	241
BC342	242	BC343	243
BC344	244	BC345	245
BC346	246	BC347	247
BC348	248	BC349	249
BC350	250	BC351	251
BC352	252	BC353	253
BC354	254	BC355	255
BC356	256	BC357	257
BC358	258	BC359	259
BC360	260	BC361	261
BC362	262	BC363	263
BC364	264	BC365	265
BC366	266	BC367	267
BC368	268	BC369	269
BC370	270	BC371	271
BC372	272	BC373	273
BC374	274	BC375	275
BC376	276	BC377	277
BC378	278	BC379	279
BC380	280	BC381	281
BC382	282	BC383	283
BC384	284	BC385	285
BC386	286	BC387	287
BC388	288	BC389	289
BC390	290	BC391	291
BC392	292	BC393	293
BC394	294	BC395	295
BC396	296	BC397	297
BC398	298	BC399	299
BC400	300	BC401	301
BC402	302	BC403	303
BC404	304	BC405	305
BC406	306	BC407	307
BC408	308	BC409	309
BC410	310	BC411	311
BC412	312	BC413	313
BC414	314	BC415	315
BC416	316	BC417	317
BC418	318	BC419	319
BC420	320	BC421	321
BC422	322	BC423	323
BC424	324	BC425	325
BC426	326	BC427	327
BC428	328	BC429	329
BC430	330	BC431	331
BC432	332	BC433	333
BC434	334	BC435	335
BC436	336	BC437	337
BC438	338	BC439	339
BC440	340	BC441	341
BC442	342	BC443	343
BC444	344	BC445	345
BC446	346	BC447	347
BC448	348	BC449	349
BC450	350	BC451	351
BC452	352	BC453	353
BC454	354	BC455	355
BC456	356	BC457	357
BC458	358	BC459	359
BC460	360	BC461	361
BC462	362	BC463	363
BC464	364	BC465	365
BC466	366	BC467	367
BC468	368	BC469	369
BC470	370	BC471	371
BC472	372	BC473	373
BC474	374	BC475	375
BC476	376	BC477	377
BC478	378	BC479	379
BC480	380	BC481	381
BC482	382	BC483	383
BC484	384	BC485	385
BC486	386	BC487	387
BC488	388	BC489	389
BC490	390	BC491	391
BC492	392	BC493	393
BC494	394	BC495	395
BC496	396	BC497	397
BC498	398	BC499	399
BC500	400	BC501	401
BC502	402	BC503	403
BC504	404	BC505	405
BC506	406	BC507	407
BC508	408	BC509	409
BC510	410	BC511	411
BC512	412	BC513	413
BC514	414	BC515	415
BC516	416	BC517	417
BC518	418	BC519	419
BC520	420	BC521	421
BC522	422	BC523	423
BC524	424	BC525	425
BC526	426	BC527	427
BC528	428	BC529	429
BC530	430	BC531	431
BC532	432	BC533	433
BC534	434	BC535	435
BC536	436	BC537	437
BC538	438	BC539	439
BC540	440	BC541	441
BC542	442	BC543	443
BC544	444	BC545	445
BC546	446	BC547	447
BC548	448	BC549	449
BC550	450	BC551	451
BC552	452	BC553	453
BC554	454	BC555	455
BC556	456	BC557	457
BC558	458	BC559	459
BC560	460	BC561	461
BC562	462	BC563	463
BC564	464	BC565	465
BC566	466	BC567	467
BC568	468	BC569	469
BC570	470	BC571	471
BC572	472	BC573	473
BC574	474	BC575	475
BC576	476	BC577	477
BC578	478	BC579	479
BC580	480	BC581	481
BC582	482	BC583	483
BC584	484	BC585	485
BC586	486	BC587	487
BC588	488	BC589	489
BC590	490	BC591	491
BC592	492	BC593	493
BC594	494	BC595	495
BC596	496	BC597	497
BC598	498	BC599	499
BC600	500	BC601	501
BC602	502	BC603	503
BC604	504	BC605	505
BC606	506	BC607	507
BC608	508	BC609	509
BC610	510	BC611	511
BC612	512	BC613	513
BC614	514	BC615	515
BC616	516	BC617	517
BC618	518	BC619	519
BC620	520	BC621	521
BC622	522	BC623	523
BC624	524	BC625	525
BC626	526	BC627	527
BC628	528	BC629	529
BC630	530	BC631	531
BC632	532	BC633	533
BC634	534	BC635	535
BC636	536	BC637	537
BC638	538	BC639	539
BC640	540	BC641	541
BC642	542	BC643	543
BC644	544	BC645	545
BC646	546	BC647	547
BC648	548	BC649	549
BC650	550	BC651	551
BC652	552	BC653	553
BC654	554	BC655	555
BC656	556	BC657	557
BC658	558	BC659	559
BC660	560	BC661	561
BC662	562	BC663	563
BC664	564	BC665	565
BC666	566	BC667	567
BC668	568	BC669	569
BC670	570	BC671	571
BC672	572	BC673	573
BC674	574	BC675	575
BC676	576	BC677	577
BC678	578	BC679	579
BC680	580	BC681	581
BC682	582	BC683	583
BC684	584	BC685	585
BC686	586	BC687	587
BC688	588	BC689	589
BC690	590	BC691	591
BC692	592	BC693	593
BC694	594	BC695	595
BC696	596	BC697	597
BC698	598	BC699	599
BC700	600	BC701	601
BC702	602	BC703	603
BC704	604	BC705	605
BC706	606	BC707	607
BC708	608	BC709	609
BC710	610	BC711	611
BC712	612	BC713	613
BC714	614	BC715	615
BC716	616	BC717	617
BC718	618	BC719	619
BC720	620	BC721	621
BC722	622	BC723	623
BC724	624	BC725	625
BC726	626	BC727	627
BC728	628	BC729	629
BC730	630	BC731	631
BC732	632	BC733	633
BC734	634	BC735	635
BC736	636	BC737	637
BC738	638	BC739	639
BC740	640	BC741	641
BC742	642	BC743	643
BC744	644	BC745	645
BC746	646	BC747	647
BC748	648	BC749	649
BC750	650	BC751	651
BC752	652	BC753	653
BC754	654	BC755	655
BC756	656	BC757	657
BC758	658	BC759	659
BC760	660	BC761	661
BC762	662	BC763	663
BC764	664	BC765	665
BC766	666	BC767	667
BC768	668	BC769	669
BC770	670	BC771	671
BC772	672	BC773	673
BC774	674	BC775	675
BC776	676	BC777	677
BC778	678	BC779	679
BC780	680	BC781	681
BC782	682	BC783	683</

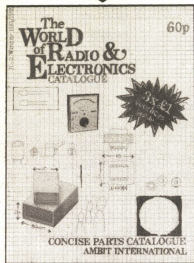
HOW TO SUCCEED IN THE ELECTRONICS BUSINESS:

Available at your
newsagent or
direct for
**60p p&p
inc**

INVEST 60p AND MAKE £2.40 net profit

Buy Ambit's new concise component catalogue and get £1 vouchers. Use them for a £1 discount per £10 spent. But even without this, you will still find WR&E offers the low prices, fast service and technical support facility second to none.

Here are some examples from the current issue:



Z80 SERIES

280A	4.99
280ADR	7.50
280API	4.10
280ASIO/1	14.00
280ASIO/2	14.00
280ASIO/8	14.00
280CTC	4.00
280ACT	4.50
28001	66.00

PROM

2708	2.00
2716	3.95
2532	8.50
2732	8.50

RAM

2102	1.70
2112	3.40
2114/2	1.48
4027	5.78
4116/2	1.59
4116/3	1.48
4864P	12.50
6116P-3	12.50
6116P-4	11.25
8254	12.50

I.C. SOCKETS

A range of high quality, low cost, low profile DIL sockets ideally suited for both the OEM and hobbyist. All types feature double sided phosphor bronze contacts, tin-plated for low contact resistance.

8 x 0.3" 12p	22 x 0.3" 20p
14 x 0.3" 13p	22 x 0.4" 20p
16 x 0.3" 13p	24 x 0.6" 22p
18 x 0.3" 18p	28 x 0.6" 25p
20 x 0.3" 19p	40 x 0.6" 35p
20 x 0.4" 19p	42 x 0.6" 35p

DISCRETES

BC237	8p
BC238	8p
ZTX238	8p
BC239	8p
BC307	8p
BC308	8p
BC309	8p
BC413	10p
BC414	11p
BC415	10p
BC416	11p
BC546	12p

BC556 12p

BC550 12p	25K168 35p
BC560 12p	33K10 60p
BC639 22p	J176 65p
BC640 22p	40023 65p
2SC1775A 22p	35K45 45p
2SA872A 18p	35K51 54p
2SD666A 30p	35K60 50p
2SB648A 30p	35K63 60p
2SD668A 30p	MEM680 75p
2SB648A 40p	BF960 95p
BF256 30p	BF961 70p
2SK55 28p	BF963 95p

XTALS

1MHz	3.00
3.2768MHz	2.00
4MHz	1.70
4.194MHz	1.70
4.43MHz	1.25
5MHz	2.00
6.5536MHz	2.00
7MHz	2.00
8MHz	2.00
9MHz	2.00
10MHz	2.00
12MHz	2.00

VOLTAGE REGULATORS

78X11A TO-220 pos	0.58
79X11A TO-220 neg	0.60
780 1A TO-220 adj pos	1.10
780 1A TO-3 adj pos	3.95
78H5A TO-3 5v pos	4.25
78H5A TO-3 12v pos	5.45
78H5A TO-3 adj pos	7.45
79H5A TO-3 adj neg	7.45
LM317.5A adj pos	1.30
LM337.5A adj neg	1.75
78S401.5A adj pos sw reg	1.20

Prices shown exclude VAT. Postage 50p per order (UK). ACCESS/ BARCLAYCARD may be used with written or telephone orders. Official names on application, and a special price for those who read our ads carefully: a free 4 or 5 MHz crystal filter with every CPU IC you buy - just clip out the paragraph and attach it to your order. E&OE. All our stock items normally despatched by return of post.

AMBIT international

TELEPHONE (STD 0277) 2309099 TELEX 995194 AMBIT G POSTCODE CM14 4SG
200 North Service Road, Brentwood, Essex



METERS: 110 x 82 x 35mm
300µA, 50µA, 100µA, 5V-90.
Post 50p.

METERS: 45 x 50 x 34mm
50µA, 100µA, 1mA, 5mA, 10mA, 25V, 1A, 2A, 15A.
SA. 25V £4-28. Post 30p.

METERS: 60 x 47 x 33mm
50µA, 100µA, 1mA, 5mA, 10mA, 100mA, 1A, 2A, 25V, 50V, 50-0-50µA, 100-0-100µA, £4-76.
VU meters. £5-32.
Post on above meters 30p.

MULTI-METER
7N 360TR
20,000 ohm/volt
DC Volts: 0-1,
0.5, 2.5, 10-150-
250-1,000V.
AC Volts: 10-50,
250-1,000
RESISTANCE
RANGES
X1, X10, X1K,
X10K
£14-10
P.A.P. 60p



TRANSFORMERS
240v Primary
3-0-3v 100mA 82p
6-0-6v 100mA 87p
6-0-6v 250mA £1-22
12-0-12v 50mA 82p
12-0-12v 100mA £1-15
Post on above transformers 48p.
9-0-9v 1A £1-80
12-0-12v 1A £2-40
15-0-15v 1A £2-60
6-3v 1A £1-80
6-0-6v 1A £2-10
Post on above transformers 87p.

COMPONENTS AT REALISTIC PRICES

A SMALL SELECTION FROM OUR LARGE RANGE

DIODES

AA100 7p, BA102 18p, BA154 18p, BA155 12p, BY125 18p, BY173 18p, BY176 65p, BY200 25p, IN4148 3p, IN44 4p, (BY176) BY476 Spec. Unmarked & Larger 30p.

SILICON RECTIFIERS

200mA 50V IN5400 5p, 100V IN5201 6p, 200V IN5202 6p, 1 AMP, 50V IN4001 4p, 100V IN4002 4p, 500V IN4003 4p, 400V IN4004 5p, 500V IN4005 5p, 500V IN4006 5p, 100V IN4007 6p, 5 AMP 200V IN4002 18p. (BARGAIN PACK OFF 50 IN4002 Unmarked & Preformed 12.5mm 56p).

TRANSISTORS

AC108 18p, AC108K 35p, AC153K 35p, AC176K 35p, AD149 60p, AD161 35p, AD169 35p, AF139 35p, AF239 35p, AL102 61-78, AU113 61-78, BC108 8p, BC147 8p, BC149 8p, BC160 22p, BC162 8p, BC163 8p, BC164 8p, BC165 8p, BC166 8p, BC167 8p, BC168 8p, BC169 8p, BC170 8p, BC171 8p, BC172 8p, BC173 8p, BC174 8p, BC175 8p, BC176 8p, BC177 8p, BC178 8p, BC179 8p, BC180 8p, BC181 8p, BC182 8p, BC183 8p, BC184 8p, BC185 8p, BC186 8p, BC187 8p, BC188 8p, BC189 8p, BC190 8p, BC191 8p, BC192 8p, BC193 8p, BC194 8p, BC195 8p, BC196 8p, BC197 8p, BC198 8p, BC199 8p, BC200 8p, BC201 8p, BC202 8p, BC203 8p, BC204 8p, BC205 8p, BC206 8p, BC207 8p, BC208 8p, BC209 8p, BC210 8p, BC211 8p, BC212 8p, BC213 8p, BC214 8p, BC215 8p, BC216 8p, BC217 8p, BC218 8p, BC219 8p, BC220 8p, BC221 8p, BC222 8p, BC223 8p, BC224 8p, BC225 8p, BC226 8p, BC227 8p, BC228 8p, BC229 8p, BC230 8p, BC231 8p, BC232 8p, BC233 8p, BC234 8p, BC235 8p, BC236 8p, BC237 8p, BC238 8p, BC239 8p, BC240 8p, BC241 8p, BC242 8p, BC243 8p, BC244 8p, BC245 8p, BC246 8p, BC247 8p, BC248 8p, BC249 8p, BC250 8p, BC251 8p, BC252 8p, BC253 8p, BC254 8p, BC255 8p, BC256 8p, BC257 8p, BC258 8p, BC259 8p, BC260 8p, BC261 8p, BC262 8p, BC263 8p, BC264 8p, BC265 8p, BC266 8p, BC267 8p, BC268 8p, BC269 8p, BC270 8p, BC271 8p, BC272 8p, BC273 8p, BC274 8p, BC275 8p, BC276 8p, BC277 8p, BC278 8p, BC279 8p, BC280 8p, BC281 8p, BC282 8p, BC283 8p, BC284 8p, BC285 8p, BC286 8p, BC287 8p, BC288 8p, BC289 8p, BC290 8p, BC291 8p, BC292 8p, BC293 8p, BC294 8p, BC295 8p, BC296 8p, BC297 8p, BC298 8p, BC299 8p, BC300 8p, BC301 8p, BC302 8p, BC303 8p, BC304 8p, BC305 8p, BC306 8p, BC307 8p, BC308 8p, BC309 8p, BC310 8p, BC311 8p, BC312 8p, BC313 8p, BC314 8p, BC315 8p, BC316 8p, BC317 8p, BC318 8p, BC319 8p, BC320 8p, BC321 8p, BC322 8p, BC323 8p, BC324 8p, BC325 8p, BC326 8p, BC327 8p, BC328 8p, BC329 8p, BC330 8p, BC331 8p, BC332 8p, BC333 8p, BC334 8p, BC335 8p, BC336 8p, BC337 8p, BC338 8p, BC339 8p, BC340 8p, BC341 8p, BC342 8p, BC343 8p, BC344 8p, BC345 8p, BC346 8p, BC347 8p, BC348 8p, BC349 8p, BC350 8p, BC351 8p, BC352 8p, BC353 8p, BC354 8p, BC355 8p, BC356 8p, BC357 8p, BC358 8p, BC359 8p, BC360 8p, BC361 8p, BC362 8p, BC363 8p, BC364 8p, BC365 8p, BC366 8p, BC367 8p, BC368 8p, BC369 8p, BC370 8p, BC371 8p, BC372 8p, BC373 8p, BC374 8p, BC375 8p, BC376 8p, BC377 8p, BC378 8p, BC379 8p, BC380 8p, BC381 8p, BC382 8p, BC383 8p, BC384 8p, BC385 8p, BC386 8p, BC387 8p, BC388 8p, BC389 8p, BC390 8p, BC391 8p, BC392 8p, BC393 8p, BC394 8p, BC395 8p, BC396 8p, BC397 8p, BC398 8p, BC399 8p, BC400 8p, BC401 8p, BC402 8p, BC403 8p, BC404 8p, BC405 8p, BC406 8p, BC407 8p, BC408 8p, BC409 8p, BC410 8p, BC411 8p, BC412 8p, BC413 8p, BC414 8p, BC415 8p, BC416 8p, BC417 8p, BC418 8p, BC419 8p, BC420 8p, BC421 8p, BC422 8p, BC423 8p, BC424 8p, BC425 8p, BC426 8p, BC427 8p, BC428 8p, BC429 8p, BC430 8p, BC431 8p, BC432 8p, BC433 8p, BC434 8p, BC435 8p, BC436 8p, BC437 8p, BC438 8p, BC439 8p, BC440 8p, BC441 8p, BC442 8p, BC443 8p, BC444 8p, BC445 8p, BC446 8p, BC447 8p, BC448 8p, BC449 8p, BC450 8p, BC451 8p, BC452 8p, BC453 8p, BC454 8p, BC455 8p, BC456 8p, BC457 8p, BC458 8p, BC459 8p, BC460 8p, BC461 8p, BC462 8p, BC463 8p, BC464 8p, BC465 8p, BC466 8p, BC467 8p, BC468 8p, BC469 8p, BC470 8p, BC471 8p, BC472 8p, BC473 8p, BC474 8p, BC475 8p, BC476 8p, BC477 8p, BC478 8p, BC479 8p, BC480 8p, BC481 8p, BC482 8p, BC483 8p, BC484 8p, BC485 8p, BC486 8p, BC487 8p, BC488 8p, BC489 8p, BC490 8p, BC491 8p, BC492 8p, BC493 8p, BC494 8p, BC495 8p, BC496 8p, BC497 8p, BC498 8p, BC499 8p, BC500 8p, BC501 8p, BC502 8p, BC503 8p, BC504 8p, BC505 8p, BC506 8p, BC507 8p, BC508 8p, BC509 8p, BC510 8p, BC511 8p, BC512 8p, BC513 8p, BC514 8p, BC515 8p, BC516 8p, BC517 8p, BC518 8p, BC519 8p, BC520 8p, BC521 8p, BC522 8p, BC523 8p, BC524 8p, BC525 8p, BC526 8p, BC527 8p, BC528 8p, BC529 8p, BC530 8p, BC531 8p, BC532 8p, BC533 8p, BC534 8p, BC535 8p, BC536 8p, BC537 8p, BC538 8p, BC539 8p, BC540 8p, BC541 8p, BC542 8p, BC543 8p, BC544 8p, BC545 8p, BC546 8p, BC547 8p, BC548 8p, BC549 8p, BC550 8p, BC551 8p, BC552 8p, BC553 8p, BC554 8p, BC555 8p, BC556 8p, BC557 8p, BC558 8p, BC559 8p, BC560 8p, BC561 8p, BC562 8p, BC563 8p, BC564 8p, BC565 8p, BC566 8p, BC567 8p, BC568 8p, BC569 8p, BC570 8p, BC571 8p, BC572 8p, BC573 8p, BC574 8p, BC575 8p, BC576 8p, BC577 8p, BC578 8p, BC579 8p, BC580 8p, BC581 8p, BC582 8p, BC583 8p, BC584 8p, BC585 8p, BC586 8p, BC587 8p, BC588 8p, BC589 8p, BC590 8p, BC591 8p, BC592 8p, BC593 8p, BC594 8p, BC595 8p, BC596 8p, BC597 8p, BC598 8p, BC599 8p, BC600 8p, BC601 8p, BC602 8p, BC603 8p, BC604 8p, BC605 8p, BC606 8p, BC607 8p, BC608 8p, BC609 8p, BC610 8p, BC611 8p, BC612 8p, BC613 8p, BC614 8p, BC615 8p, BC616 8p, BC617 8p, BC618 8p, BC619 8p, BC620 8p, BC621 8p, BC622 8p, BC623 8p, BC624 8p, BC625 8p, BC626 8p, BC627 8p, BC628 8p, BC629 8p, BC630 8p, BC631 8p, BC632 8p, BC633 8p, BC634 8p, BC635 8p, BC636 8p, BC637 8p, BC638 8p, BC639 8p, BC640 8p, BC641 8p, BC642 8p, BC643 8p, BC644 8p, BC645 8p, BC646 8p, BC647 8p, BC648 8p, BC649 8p, BC650 8p, BC651 8p, BC652 8p, BC653 8p, BC654 8p, BC655 8p, BC656 8p, BC657 8p, BC658 8p, BC659 8p, BC660 8p, BC661 8p, BC662 8p, BC663 8p, BC664 8p, BC665 8p, BC666 8p, BC667 8p, BC668 8p, BC669 8p, BC670 8p, BC671 8p, BC672 8p, BC673 8p, BC674 8p, BC675 8p, BC676 8p, BC677 8p, BC678 8p, BC679 8p, BC680 8p, BC681 8p, BC682 8p, BC683 8p, BC684 8p, BC685 8p, BC686 8p, BC687 8p, BC688 8p, BC689 8p, BC690 8p, BC691 8p, BC692 8p, BC693 8p, BC694 8p, BC695 8p, BC696 8p, BC697 8p, BC698 8p, BC699 8p, BC700 8p, BC701 8p, BC702 8p, BC703 8p, BC704 8p, BC705 8p, BC706 8p, BC707 8p, BC708 8p, BC709 8p, BC710 8p, BC711 8p, BC712 8p, BC713 8p, BC714 8p, BC715 8p, BC716 8p, BC717 8p, BC718 8p, BC719 8p, BC720 8p, BC721 8p, BC722 8p, BC723 8p, BC724 8p, BC725 8p, BC726 8p, BC727 8p, BC728 8p, BC729 8p, BC730 8p, BC731 8p, BC732 8p, BC733 8p, BC734 8p, BC735 8p, BC736 8p, BC737 8p, BC738 8p, BC739 8p, BC740 8p, BC741 8p, BC742 8p, BC743 8p, BC744 8p, BC745 8p, BC746 8p, BC747 8p, BC748 8p, BC749 8p, BC750 8p, BC751 8p, BC752 8p, BC753 8p, BC754 8p, BC755 8p, BC756 8p, BC757 8p, BC758 8p, BC759 8p, BC760 8p, BC761 8p, BC762 8p, BC763 8p, BC764 8p, BC765 8p, BC766 8p, BC767 8p, BC768 8p, BC769 8p, BC770 8p, BC771 8p, BC772 8p, BC773 8p, BC774 8p, BC775 8p, BC776 8p, BC777 8p, BC778 8p, BC779 8p, BC780 8p, BC781 8p, BC782 8p, BC783 8p, BC784 8p, BC785 8p, BC786 8p, BC787 8p, BC788 8p, BC789 8p, BC790 8p, BC791 8p, BC792 8p, BC793 8p, BC794 8p, BC795 8p, BC796 8p, BC797 8p, BC798 8p, BC799 8p, BC800 8p, BC801 8p, BC802 8p, BC803 8p, BC804 8p, BC805 8p, BC806 8p, BC807 8p, BC808 8p, BC809 8p, BC810 8p, BC811 8p, BC812 8p, BC813 8p, BC814 8p, BC815 8p, BC816 8p, BC817 8p, BC818 8p, BC819 8p, BC820 8p, BC821 8p, BC822 8p, BC823 8p, BC824 8p, BC825 8p, BC826 8p, BC827 8p, BC828 8p, BC829 8p, BC830 8p, BC831 8p, BC832 8p, BC833 8p, BC834 8p, BC835 8p, BC836 8p, BC837 8p, BC838 8p, BC839 8p, BC840 8p, BC841 8p, BC842 8p, BC843 8p, BC844 8p, BC845 8p, BC846 8p, BC847 8p, BC848 8p, BC849 8p, BC850 8p, BC851 8p, BC852 8p, BC853 8p, BC854 8p, BC855 8p, BC856 8p, BC857 8p, BC858 8p, BC859 8p, BC860 8p, BC861 8p, BC862 8p, BC863 8p, BC864 8p, BC865 8p, BC866 8p, BC867 8p, BC868 8p, BC869 8p, BC870 8p, BC871 8p, BC872 8p, BC873 8p, BC874 8p, BC875 8p, BC876 8p, BC877 8p, BC878 8p, BC879 8p, BC880 8p, BC881 8p, BC882 8p, BC883 8p, BC884 8p, BC885 8p, BC886 8p, BC887 8p, BC888 8p, BC889 8p, BC890 8p, BC891 8p, BC892 8p, BC893 8p, BC894 8p, BC895 8p, BC896 8p, BC897 8p, BC898 8p, BC899 8p, BC900 8p, BC901 8p, BC902 8p, BC903 8p, BC904 8p, BC905 8p, BC906 8p, BC907 8p, BC908 8p, BC909 8p, BC910 8p, BC911 8p, BC912 8p, BC913 8p, BC914 8p, BC915 8p, BC916 8p, BC917 8p, BC918 8p, BC919 8p, BC920 8p, BC921 8p, BC922 8p, BC923 8p, BC924 8p, BC925 8p, BC926 8p, BC927 8p, BC928 8p, BC929 8p, BC930 8p, BC931 8p, BC932 8p, BC933 8p, BC934 8p, BC935 8p, BC936 8p, BC937 8p, BC938 8p, BC939 8p, BC940 8p, BC941 8p, BC942 8p, BC943 8p, BC944 8p, BC945 8p, BC946 8p, BC947 8p, BC948 8p, BC949 8p, BC950 8p, BC951 8p, BC952 8p, BC953 8p, BC954 8p, BC955 8p, BC956 8p, BC957 8p, BC958 8p, BC959 8p, BC960 8p, BC961 8p, BC962 8p, BC963 8p, BC964 8p, BC965 8p, BC966 8p, BC967 8p, BC968 8p, BC969 8p, BC970 8p, BC971 8p, BC972 8p, BC973 8p, BC974 8p, BC975 8p, BC976 8p, BC977 8p, BC978 8p, BC979 8p, BC980 8p, BC981 8p, BC982 8p, BC983 8p, BC984 8p, BC985 8p, BC986 8p, BC987 8p, BC988 8p, BC989 8p, BC990 8p, BC991 8p, BC992 8p, BC993 8p, BC994 8p, BC995 8p, BC996 8p, BC997 8p, BC998 8p, BC999 8p, BC1000 8p.

TANT BEADS, Price 10 (100T)

1/32 15p (Rp), 2/32 15p (Rp), 3/32 15p (Rp), 4/32 15p (Rp), 5/32 15p (Rp), 6/32 15p (Rp), 7/32 15p (Rp), 8/32 15p (Rp), 9/32 15p (Rp), 10/32 15p (Rp), 11/32 15p (Rp), 12/32 15p (Rp), 13/32 15p (Rp), 14/32 15p (Rp), 15/32 15p (Rp), 16/32 15p (Rp), 17/32 15p (Rp), 18/32 15p (Rp), 19/32 15p (Rp), 20/32 15p (Rp), 21/32 15p (Rp), 22/32 15p (Rp), 23/32 15p (Rp), 24/32 15p (Rp), 25/32 15p (Rp), 26/32 15p (Rp), 27/32 15p (Rp), 28/32 15p (Rp), 29/32 15p (Rp), 30/32 15p (Rp), 31/32 15p (Rp), 32/32 15p (Rp), 33/32 15p (Rp), 34/32 15p (Rp), 35/32 15p (Rp), 36/32 15p (Rp), 37/32 15p (Rp), 38/32 15p (Rp), 39/32

7

ALCON

CONTINUE THEIR SPECIAL OFFER

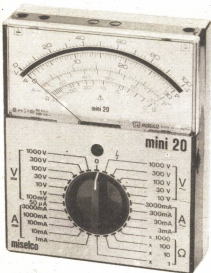
mini 20

20k Ω /V d.c. — 6.6k Ω /V a.c.

multimeter

only £19.50

INCLUSIVE OF POST
PACKAGE—V.A.T.



The Mini 20 is an ideal instrument for the constructor.

This special offer is a wonderful opportunity to acquire an essential piece of test gear with a saving of nearly £10 on the normal retail price.

The 26 ranges cover all likely requirements. Operation is straightforward, just turn the selection switch to the required range.

RANGES:

d.c.V: 100mV, 1V, 10V, 30V, 100V, 300V, 1000V.

a.c.V: 10V, 30V, 100V, 300V, 1000V.

d.c.I: 50 μ A, 1mA, 10mA, 100mA, 1A, 3A.

a.c.I: 3mA, 30mA, 300mA, 3A.

Ohms: 0-1k Ω , 10k Ω , 100k Ω , 1M Ω .

Accuracy: 2% d.c. & resistance, 3% a.c.

Dimensions: 105 x 130 x 40mm

Movement protected by internal diode and fuse.

The instrument is supplied complete with case, leads and instructions.

For details of this and the many other exciting instruments in the Alcon range, including multimeters, component measuring and electronic instruments please write or telephone:

ALCON Instruments Ltd.

19 MULBERRY WALK • LONDON SW3 6DZ • TEL: 01-352 1897 • TELEX: 918867

EE PROJECT KITS

Make us your No. 1 SUPPLIER OF KITS AND COMPONENTS for E.E. Projects. We supply carefully selected sets of parts to enable you to construct E.E. projects. Kits include ALL the ELECTRONICS and HARDWARE you need. No circling boards or components to be drilled and roller tinned or Varo-boarded, of course, included as specified in the original article, we even include nuts, screws and I.C. sockets. PRICES INCLUDE CASES unless otherwise stated. BATTERIES ARE NOT INCLUDED. COMMENT: Set in! Set in! If you do not have the issue of E.E. which includes the project—you will need to order the instruction reprint at an extra 45p each.

Reprints available separately 45p each + p. & p.

- ELECTRONIC IGNITION.** Nov. 81. £24.52.
SIMPLE INFRA RED REMOTE CONTROL. Nov. 81. £15.84.
LOUDHAIRER. Nov. 81. less handle. £11.93.
HORN SPEAKER. £6.75 extra.
PRESSURE MAT TRIGGER ALARM. Nov. 81. £5.95 less mat.
EXPERIMENTER CRYSTAL SET. Nov. 81. Less aerial. £3.90.
Headphones. £2.98 extra.
CAPACITANCE METER. Oct. 81. £21.98.
SUSTAIN UNIT. Oct. 81. £11.93.
'POPULAR DESIGNS'. Oct. 81.
SNAP INDICATOR. £3.18.
DAMP LOCATOR. £1.51.
TAPE NOISE LIMITER. £4.25.
HEADS AND TAILS GAME. £2.26.
CONTINUITY TESTER. £2.70.
PHOTO FLASH SLAVE. £3.24.
FUZZ BOX. £2.82.
OPTO ALARM. £8.58.
SOIL MOISTURE UNIT. £3.43.
ICE ALARM. £7.28.
MODEL RAILWAY SPEED CONTROLLER. Sept. 81. £13.48.
6-12V POWER SUPPLY. Sept. 81. £16.84.
CMOS CAR SECURITY ALARM. Sept. 81. £8.48.
CMOS DIE. Sept. 81. £7.47.
LED SANDGLASS. Aug. 81. £7.98.
WHEEL OF FORTUNE. Aug. 81. less wire, panel and case. £39.95.
CMOS METRONOME. Aug. 81. £7.78.
COMBINATION LOCK. July 81. Less case. £18.50.
BURGULAR ALARM SYSTEM. June 81 less bell, loop & Mic's. £38.30.
TAPE AUTO START. June 81. £11.96.
TREMOLO. June 81. Less case. £16.48.
LOOP AERIAL CRYSTAL SET. June 81. £3.47.
LIGHTS REMINDER AND IGNITION LOCATOR E.E. May 81. £3.28.
SOIL MOISTURE INDICATOR E.E. May 81. £3.83.
T.V. INTERFERENCE FILTERS E.E. May 81. LOW PASS less tipplate £2.82. HIGH PASS £1.58.
GUITAR HEADPHONE AMPLIFIER E.E. May 81. £3.96.
PHONE BELL REPEATER / BABY ALARM E.E. May 81. £3.28.
DIGITAL RULE (ultrasonic) April 81. £29.59.
INTERCOM. April 81. £20.78.
SIMPLE TRANSISTOR & DIODE TESTERS. Mar. 81. Ohmmeter version £1.85. LED version £2.56.
MINI SIREN. Mar. 81. £7.52.
ED DICE. Mar. 81. £7.68.
LED FLASHER. Mar. 81. £4.81.
MODULATED TONE DOORBELL. Mar. 81. £6.21.
BENCH POWER SUPPLY. Mar. 81. £49.95.
TREBLE BOOST. Mar. 81. £5.84.
CAR ACTUATED DRIVEWAY LIGHT. Feb. 81 less socket. £23.95.
THREE CHANNEL STEREO MIXER. Feb. 81. £17.47.
SIGNAL TRACER. Feb. 81. £7.64 less probe.
FOUR BAND RADIO. Feb. 81. £39.98.
N.C-BD BATTERY CHARGER. Feb. 81. £15.75.
ULTRASONIC INTRUDER DETECTOR. Jan. 81 less case. £48.98.
AUTO SLIDE CHANGER. Jan. 81. £9.28.
LOGIC PULSE GENERATOR. Jan. 81. £7.48.
2 NOTE DOOR CHIME. Dec. 80. £6.85.
LIVE WIRE GAME. Dec. 80. £19.94.
BENCH POWER SUPPLY. Nov. 80. £11.98 less case. Standard case £3.88. High quality case £2.33.
SOUND TO LIGHT. Nov. 80. 3 channel. £19.95.
TRANSISTOR TESTER. Nov. 80. £24.97.
AUDIO EFFECTS UNIT FOR WEIRD SOUNDS. Oct. 80. £15.28.
PHONE CALL CHARGE JOGGER. Oct. 80. £6.88.
BICYCLE ALARM. Oct. 80. £9.68 less mounting brackets.
IRON HEAT CONTROL. Oct. 80. £5.48.
BEDSIDE RADIO. Sept. 80. £17.57.
6-12V DC COLD PROBE. Sept. 80. £4.85.
COURTESY LIGHT DELAY. June 80. £8.89.
SIGNAL TRACER. June 80. £5.98.
ZENER DIODE TESTER. June 80. £6.24.
4 STATION RADIO. May 80. £15.33 less case.
LIGHTS WARNING SYSTEM. May 80. £4.28.
BATTERY VOLTAGE MONITOR. May 80. £4.23.
CABLE & PIPE LOCATOR. Mar. 80. £3.85.
KITCHEN TIMER. Mar. 80. £13.78.
STEREO HEADPHONE AMPLIFIER. Mar. 80. £16.97.
MICRO MUSIC BOX. Feb. 80. £15.28.
SIMPLE SHORT WAVE RECEIVER. Feb. 80. £24.17.
SLIDE/TAPE SYNCHRONISER. Feb. 80. £11.56.
NOISE PRACTICE OSCILLATOR. Feb. 80. £4.35.
SPRING LINE REVERB. UNIT. Jan. 80. £24.17.
6-12V DOOR BURGULAR ALARM. Dec. 79. £5.84.
BABY ALARM. Nov. 79. £8.98.
ONE ARMED BANDIT. Oct. 79. £24.68.
HIGH IMPEDANCE VOLTMETER. Oct. 79. £11.93.
CHASSIS LIGHTS. Sept. 79. £21.97.
SIMPLE TRANSISTOR TESTER. Sept. 79. £8.68.
ELECTRONIC TUNING FORK. Aug. 79. £9.99.
SONIC. Aug. 79. £11.93.
DARKROOM TIMER. July 79. £21.11.
TRANSISTOR CANARY. July 79. £5.48.
TRANSISTOR TESTER. April 79. £4.95.
TRANSISTOR TESTER. April 79. £2.87.
ONE TRANSISTOR RADIO. Mar. 79 less case £7.62.
MICROPHONE DOORBELL. Feb. 79. £14.82.
TRANSISTOR TESTER. Feb. 79. £23.54.
ADJUSTABLE PSU. Feb. 79. £31.87.
HEADPHONE ENHANCER. Jan. 79. £2.88.
NIC. AMP. Dec. 78. £3.68.
AUDIBLE FLASHER. Dec. 78. £5.33.
VEHICLE IMMOBILISER. Dec. 78. £4.31.
FUSE CHECKER. Oct. 78. £2.16.
TREASURE HUNTER. Oct. 78. £19.94 less handle & coil former.
SOUND TO LIGHT. Oct. 78. £7.67.
CAR BATTERY STATE INDICATOR. Sept. 78. Less case. £1.96.
R.F. SIGNAL GENERATOR. Sept. 78. £24.98.
6-12V FLASH. Aug. 78. £32.95.
IN SITU TRANSISTOR TESTER. July 78. £4.95.
POCKET TIMER. April 78. £3.27.
WEIRD SOUND EFFECTS GENERATOR. Mar. 78. £5.28.
AUDIO VISUAL METRONOME. Jan. 78. £3.63.
ELECTRONIC TOUCH SWITCH. Jan. 78. £6.96 less case.
FLAME DETECTION CHECK. Jan. 78. £2.57.
AUTOMATIC PHASE BOX. Dec. 77. £11.98 less case.
PHONE DOORBELL REPEATER. July 77. £8.98.
ELECTRONIC DICE. Mar. 77. £5.91.

LATEST KITS: S.A.E. or 'PHONE FOR PRICES

TRAIN SET ACCESSORIES

MODEL RAILWAY SPEED CONTROLLER

From E.E. Sept 81. Features fully variable speed control—from zero to full speed. Forward/Reverse switch. Auto start and stop for realism. Brake speed boost. Emergency stop. Use with the simple controller supplied with most train sets. Housed in an attractive 2 tone sloping front case built on a printed circuit board. All parts included. Kit. £13.44. Reprint/instructions extra 45p.

TRAIN SOUNDS—from E.E.

1. A SLOTTED WHISTLE. Mar. 81 £12.26 less case.
2. TWO TONE TRAIN HORN. Feb. 81. £5.24 less case.
3. CHUFFER. Jan. 81. £7.94 less case.
All 3 can be built into the whistle project case—or built as separate units.

BOOK—MODEL RAILWAY PROJECTS by Penfold £1.95. Published Sept. 81.

PCBs

for

E.E.

ELECTRONIC IGNITION.

- Nov. 81. £3.45
MODEL RAILWAY SPEED CONTROLLER. Sept. 81. £2.98
CMOS DIE. Sept. 81. £2.98
WHEEL OF FORTUNE. Aug. 81 (pair). £4.98
COMBINATION LOCK. July 81. £1.98
BENCH POWER SUPPLY. Mar. 81. £5.35
MODEL RAILWAY POINTS CONTROLLER. Mar. 81. £1.85
SOUND TO LIGHT. Nov. 80. £2.35
GAS SENTINEL. Apr. 80. £2.25

C108D	58p	2N5457	58p	BFY91	24p
C104B	48p	2N5454	48p	BFY92	24p
QA47	11p	40073	38p	BFY98	24p
QA302	11p	90	AC128	90	BR738
W006	33p	100	AC141	38p	MPSA65
W006	33p	100	AC142	38p	RPV34
W006	47p	AC178	37p	TP131A	52p
22 10k	22 10k	22 10k	22 10k	22 10k	22 10k
1N4001	51p	8C182L	11p	TP123A	94p
1N4005	6p	8C183	11p	TP124A	94p
1N4048	10p	8C184	11p	TP125A	94p
1N4049	10p	8C184L	11p	TP125S	94p
1N4050	10p	8C185	11p	TP126A	94p
BP94A	87p	8C120L	11p	TP1543	43p
BP94B	87p	8C121	11p	TP1544	43p
TP1585A	87p	8C121A	11p	TP1545	43p
TP1585B	87p	8C121A	11p	TP1546	43p
TP1585C	87p	8C121A	11p	TP1547	43p
TP1585D	87p	8C121A	11p	TP1548	43p
TP1585E	87p	8C121A	11p	TP1549	43p
TP1585F	87p	8C121A	11p	TP1550	43p
TP1585G	87p	8C121A	11p	TP1551	43p
TP1585H	87p	8C121A	11p	TP1552	43p
TP1585I	87p	8C121A	11p	TP1553	43p
TP1585J	87p	8C121A	11p	TP1554	43p
TP1585K	87p	8C121A	11p	TP1555	43p
TP1585L	87p	8C121A	11p	TP1556	43p
TP1585M	87p	8C121A	11p	TP1557	43p
TP1585N	87p	8C121A	11p	TP1558	43p
TP1585O	87p	8C121A	11p	TP1559	43p
TP1585P	87p	8C121A	11p	TP1560	43p
TP1585Q	87p	8C121A	11p	TP1561	43p
TP1585R	87p	8C121A	11p	TP1562	43p
TP1585S	87p	8C121A	11p	TP1563	43p
TP1585T	87p	8C121A	11p	TP1564	43p
TP1585U	87p	8C121A	11p	TP1565	43p
TP1585V	87p	8C121A	11p	TP1566	43p
TP1585W	87p	8C121A	11p	TP1567	43p
TP1585X	87p	8C121A	11p	TP1568	43p
TP1585Y	87p	8C121A	11p	TP1569	43p
TP1585Z	87p	8C121A	11p	TP1570	43p

LINEAR I.C.s		LM3917N	£2 27
555	32p	LM3900W	£5 95
556	78p	LM3909N	£1 95
741	28p	LM3911N	£1 95
748	55p	LM3914N	£2 80
CA3080	£1 21	LM3915N	£2 80
CA3100	£1 21	LM3916N	£2 80
CA3130T	£1 12	TBA820	£1 59
CA3140E	57p	TLO84	£2 59
CA3138	£2 85	UZ837	£1 49
HC1781	£1 84	ULN28GB	£1 67
ICM755	£1 84	ZN103AE	£1 59
ICM755S	£1 19	ZN414	£1 59
LF351	58p	LM319CE	£2 09
LF353	96p	LM3404E	£2 14
LF356	96p	ZN425E	£2 59
LM314N	58p	CMOS	
LM390K	£2 59	4001	27p
LM317K	£2 59	4011	28p

CMOS	10p	74VHC00	10p
CMOS	10p	74VHC01	10p
CMOS	10p	74VHC02	10p
CMOS	10p	74VHC03	10p
CMOS	10p	74VHC04	10p
CMOS	10p	74VHC05	10p
CMOS	10p	74VHC06	10p
CMOS	10p	74VHC07	10p
CMOS	10p	74VHC08	10p
CMOS	10p	74VHC09	10p
CMOS	10p	74VHC10	10p
CMOS	10p	74VHC11	10p
CMOS	10p	74VHC12	10p
CMOS	10p	74VHC13	10p
CMOS	10p	74VHC14	10p
CMOS	10p	74VHC15	10p
CMOS	10p	74VHC16	10p
CMOS	10p	74VHC17	10p
CMOS	10p	74VHC18	10p
CMOS	10p	74VHC19	10p
CMOS	10p	74VHC20	10p
CMOS	10p	74VHC21	10p
CMOS	10p	74VHC22	10p
CMOS	10p	74VHC23	10p
CMOS	10p	74VHC24	10p
CMOS	10p	74VHC25	10p
CMOS	10p	74VHC26	10p
CMOS	10p	74VHC27	10p
CMOS	10p	74VHC28	10p
CMOS	10p	74VHC29	10p
CMOS	10p	74VHC30	10p
CMOS	10p	74VHC31	10p
CMOS	10p	74VHC32	10p
CMOS	10p	74VHC33	10p
CMOS	10p	74VHC34	10p
CMOS	10p	74VHC35	10p
CMOS	10p	74VHC36	10p
CMOS	10p	74VHC37	10p
CMOS	10p	74VHC38	10p
CMOS	10p	74VHC39	10p
CMOS	10p	74VHC40	10p
CMOS	10p	74VHC41	10p
CMOS	10p	74VHC42	10p
CMOS	10p	74VHC43	10p
CMOS	10p	74VHC44	10p
CMOS	10p	74VHC45	10p
CMOS	10p	74VHC46	10p
CMOS	10p	74VHC47	10p
CMOS	10p	74VHC48	10p
CMOS	10p	74VHC49	10p
CMOS	10p	74VHC50	10p
CMOS	10p	74VHC51	10p
CMOS	10p	74VHC52	10p
CMOS	10p	74VHC53	10p
CMOS	10p	74VHC54	10p
CMOS	10p	74VHC55	10p
CMOS	10p	74VHC56	10p
CMOS	10p	74VHC57	10p
CMOS	10p	74VHC58	10p
CMOS	10p	74VHC59	10p
CMOS	10p	74VHC60	10p
CMOS	10p	74VHC61	10p
CMOS	10p	74VHC62	10p
CMOS	10p	74VHC63	10p
CMOS	10p	74VHC64	10p
CMOS	10p	74VHC65	10p
CMOS	10p	74VHC66	10p
CMOS	10p	74VHC67	10p
CMOS	10p	74VHC68	10p
CMOS	10p	74VHC69	10p
CMOS	10p	74VHC70	10p
CMOS	10p	74VHC71	10p
CMOS	10p	74VHC72	10p
CMOS	10p	74VHC73	10p
CMOS	10p	74VHC74	10p
CMOS	10p	74VHC75	10p
CMOS	10p	74VHC76	10p
CMOS	10p	74VHC77	10p
CMOS	10p	74VHC78	10p
CMOS	10p	74VHC79	10p
CMOS	10p	74VHC80	10p
CMOS	10p	74VHC81	10p
CMOS	10p	74VHC82	10p
CMOS	10p	74VHC83	10p
CMOS	10p	74VHC84	10p
CMOS	10p	74VHC85	10p
CMOS	10p	74VHC86	10p
CMOS	10p	74VHC87	10p
CMOS	10p	74VHC88	10p
CMOS	10p	74VHC89	10p
CMOS	10p	74VHC90	10p
CMOS	10p	74VHC91	10p
CMOS	10p	74VHC92	10p
CMOS	10p	74VHC93	10p
CMOS	10p	74VHC94	10p
CMOS	10p	74VHC95	10p
CMOS	10p	74VHC96	10p
CMOS	10p	74VHC97	10p
CMOS	10p	74VHC98	10p
CMOS	10p	74VHC99	10p
CMOS	10p	74VHC100	10p

LEACHEN 82

NEW SERIES—ALL COMPONENTS IN STOCK NOW FOR FAST DELIVERY. All top quality components as specified by Everyday Electronics. Our kit comes complete with **FREE COMPONENT IDENTIFICATION SHEET.** Follow this educational series and learn about electronics—Start today.

Send £2.98 for List 1, 2. VERO/E.E. £1.00 vouchers accepted.

WOODEN CASE KIT also available. £11.98—wood, formula, glue, saws etc. Cut to size.

IDEAL SOLDERING EQUIPMENT FOR THE TEACH IN AND ELECTRONICS

ANTEX X5 SOLDERING IRON
25W £5.48
SOLDERING IRON STAND £2.40

SPARE BITS. Small standard, large, 65p each. For X5+X25.
SOLDER. Handy size 99p.
HOW TO SOLDER LEAFLET 12p

DESOLDER BRAID 80p
HEAT SINK TWEEZERS 25p
DESOLDER PUMP £6.48
SOLDER CARTON £1.94
LOW COST CUTTERS £1.98
LOW COST LONG NOSE PLIERS £1.98
WIRE STRIPPERS & CUTTERS £2.98

BOOKS

SEMICONDUCTOR DATA BOOK, Newnes.	£3.95
MICROPROCESSORS FOR HOBBISTS, R. Coles	£3.95
PRACTICAL ELECTRONIC PROJECT BUILDING, Ansell & Colwell	£3.95
CONSTRUCTOR'S PROJECT BOOKS	£3.95
ELECTRONIC GAME PROJECTS, Rayer	£3.95
ELECTRONIC PROJECTS FOR HOME SECURITY, Bishop	£3.95
ELECTRONIC PROJECTS IN AUDIO, Penfold	£3.95
ELECTRONIC PROJECTS IN MUSIC, Bishop	£3.95
ELECTRONIC PROJECTS IN PHOTOGRAPHY, Penfold	£3.95
ELECTRONIC PROJECTS IN THE CAR, Group	£3.95
PROJECTS IN AMATEUR RADIO & SHORT WAVE LISTENING, Rayer	£3.95
PROJECTS IN RADIO AND ELECTRONICS, Sinclair	£3.95
ELECTRONIC PROJECTS IN HOBBIES, Rayer	£3.95
ELECTRONIC PROJECTS IN THE HOME, Bishop	£3.95
ELECTRONIC PROJECTS IN THE WORKSHOP, Bishop	£3.95
ELECTRONIC TEST EQUIPMENT PROJECTS, Ansell	£3.95
MOBILE PROJECTS IN THE CAR, Group	£3.95
110 ELECTRONIC ALARM PROJECTS FOR THE HOME CONSTRUCTOR	£3.95
ELECTRONIC PROJECTS—PAPERMAC	£3.95
COST EFFECTIVE PROJECTS AROUND THE HOME, Watson	£3.95
PROJECTS IN THE CAR AND GARDEN, Bishop	£3.95
AUDIO CIRCUITS AND PROJECTS, Bishop	£3.95

Step-by-step fully illustrated assembly and fitting instructions are included together with circuit descriptions. Highest quality components are used throughout.

Sparkrite

BRANDLEADING ELECTRONICS

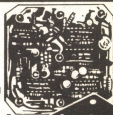
NOW AVAILABLE IN KIT FORM

SX1000 Electronic Ignition

- Inductive Discharge
- Extended coil energy storage circuit
- Contact breaker driven
- Three position changeover switch
- Over 65 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles

MAGIDICE Electronic Dice

- Not an auto item but great fun for the family
- Total random selection
- Triggered by waving of hand over dice
- Bleeps and flashes during a 4 second tumble sequence
- Throw displayed for 10 seconds
- Auto display of last throw 1 second in 5
- Muting and Off switch on base
- Hours of continuous use from PP7 battery
- Over 100 components to assemble
- Supplied in superb presentation gift box



SX2000 Electronic Ignition

- The brandleading system on the market today
- Unique Reactive Discharge
- Combined Inductive and Capacitive Discharge
- Contact breaker driven
- Three position changeover switch
- Over 130 components to assemble
- Patented clip-to-coil fitting
- Fits all 12v neg. earth vehicles

TX2002 Electronic Ignition

- The ultimate system ● Switchable contactless ● Three position switch with Auxiliary back-up inductive circuit.
- Reactive Discharge. Combined capacitive and inductive.
- Extended coil energy storage circuit.
- Magnetic contactless distributor triggerhead.
- Distributor triggerhead adaptors included.
- Can also be triggered by existing contact breakers.
- Die cast waterproof case with clip-to-coil fitting
- Fits majority of 4 and 6 cylinder 12v neg. earth vehicles.
- Over 150 components to assemble

AT-80 Electronic Car Security System

- Arms doors, boot, bonnet and has security loop to protect fog/spot lamps, radio/tape, CB equipment
- Programmable personal code entry system
- Armed and disarmed from outside vehicle using a special magnetic key fob against a windscreen sensor pad adhered to the inside of the screen
- Fits all 12V neg earth vehicles
- Over 250 components to assemble

VOYAGER Car Drive Computer

- A most sophisticated accessory. ● Utilises a single chip mask programmed microprocessor incorporating a unique programme designed by EDA Sparkrite Ltd.
- Affords 12 functions centred on Fuel, Speed, Distance and Time.
- Visual and Audible alarms warning of Excess Speed, Frost/Ice, Lights-left-on.
- Facility to operate LOG and TRIP functions independently or synchronously.
- Large 10mm high 400ft-L fluorescent display with auto intensity.
- Unique speed and fuel transducers giving a programmed accuracy of + or - 1%.
- Large LOG & TRIP memories. 2,000 miles. 180 gallons. 100 hours.
- Full Imperial and Metric calibrations.
- Over 300 components to assemble
- A real challenge for the electronics enthusiast!

ALL EDA-SPARKRITE products and designs are fully covered by one or more World Patents.

EDA SPARKRITE LIMITED 82 Bath Street, Walsall, West Midlands, WS1 3DE England. Tel: (0922) 614791

Please allow 28 days for delivery

NAME _____
ADDRESS _____

EE 1/82

I ENCLOSE CHEQUE(S)/POSTAL ORDERS FOR

£ _____ KIT REF _____

CHEQUE NO. _____
24hr. Answerphone
PHONE YOUR ORDER WITH ACCESS/BARCLAYCARD
SEND ONLY SAE IF BROCHURE IS REQUIRED

	SELF ASSEMBLY KIT	READY BUILT UNITS
SX 1000	£12.75	£27.95
SX 2000	£19.95	£43.75
TX 2002	£29.95	£62.95
AT. 80	£24.95	£49.75
VOYAGER	£49.95	£84.75
MAGIDICE	£12.95	£19.95

PRICES INC. VAT. POSTAGE & PACKING

BRANDLEADING BRITISH ELECTRONICS

CUT OUT THE COUPON NOW!

Everyday ELECTRONICS

VOL. 11 NO. 1 JANUARY 1982

Editor
F. E. BENNETT

Assistant Editor
B. W. TERRELL B.Sc.

Production Editor
D. G. BARRINGTON

Technical Sub-Editor
G. P. HODGSON

Art Editor
R. F. PALMER

Assistant Art Editor
P. A. LOATES

Technical Illustrator
D. J. GOODING Tech. (CEI)

Secretary
JACQUELINE DOIDGE

Editorial Offices
KINGS REACH TOWER
STAMFORD STREET
LONDON SE1 9LS
Phone: 01-261 6673

Advertisement Manager
R. SMITH
Phone: 01-261 6671

Representative
R. WILLET
Phone: 01-261 6865

Classified Supervisor
B. BLAKE
Phone: 01-261 5897

Make-Up and Copy Department
Phone: 01-261 6615

Advertisement Offices
KINGS REACH TOWER
STAMFORD STREET
LONDON SE1 9LS

Readers' Enquiries

We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.

We cannot undertake to engage in discussions on the telephone.

Component Supplies

Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

All reasonable precautions are taken to ensure that the advice and data given to readers are reliable. We cannot however guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

INFORMATION YEAR

The start of a new year offers an excuse for recalling the past and anticipating the future. When our ruminations involve electronics we quickly come to realise that much has happened to justify earlier predictions and that today we live in a society very dependent both for work and pleasure upon the products created by this technology. A world without electronics is simply not imaginable to anyone under around forty. And it is a fair bet that even those whose memories can take them back to the days before electronics entered the vocabulary would be reluctant to do without their TV or hi-fi, or maybe personal computer, to say nothing of the countless less obvious but very important electronic appurtenances that contribute "behind the scenes" to the higher standard of living we enjoy today.

A notable development over the past few years has been the bringing together of different branches of applied electronics to form comprehensive systems where, for example, vision and sound are complementary to computing, and where distance between equipments has become no object thanks to flexible telecommunications networks, which may include space satellites.

This kind of integration of electronic functions is well illustrated by Information Technology. The purpose of this newly created, or rather newly labelled, technology is to exploit computing and other data processing techniques by co-ordinating them with the latest methods for communicating and interfacing with people or other machines. The ability to have immediate access to vast stores of facts and figures with computing capabilities also on hand is bound to transform the running of businesses, industries and large administration centres like governmental departments. Eventually similar facilities will be available in the home, Prestel viewdata and Teletext being a taste of what is to come.

There are, of course, social as well as economic implications in the large scale use of Information Technology. Will we be able to make sensible use of all the data and information likely to be instantly available? How secure will these information sources be; will it be possible to ensure that private and confidential information does not get into the wrong hands—or onto the wrong VDU screen?

But whatever forebodings there may be, there can be no doubt about the coming of the "information revolution." For vested commercial interests have a powerful ally in the Government. Information has become the in-thing, a vital aid to economic recovery, no less. To ram this fact home, the Minister of State appointed to watch over this young technology announced recently that 1982 has been designated Information Technology Year. So everyone should get the message during the coming months, even though it's via the old fashioned printed word in newspaper or magazine.



Back Issues

Certain back issues of EVERYDAY ELECTRONICS are available worldwide price 80p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.

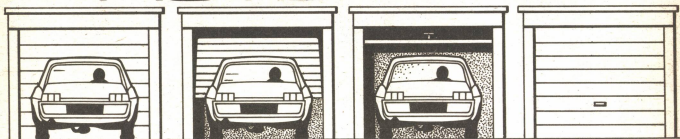
Binders

Binders to hold one volume (12 issues) are available from the above address for £4.30 (home) £4.55 (overseas) inclusive of postage and packing. Please state which Volume.

Subscriptions

Annual subscription for delivery direct to any address in the UK: £11.00. Overseas: £12.00. Cheques should be made payable to IPC Magazines Ltd., and sent to Room 2613, Kings Reach Tower, Stamford Street, London SE1 9LS.

AUTOMATIC



GARAGE DOOR

PART ONE

BY P. HORSEY

IN THIS age of automation surprisingly few people are able to enjoy the benefits of an automatic garage door. Yet what could be more luxurious, on those cold, wet and windy days, than driving towards a door which obediently opens before you at the press of a button.

Commercially available automatic doors can be very expensive, so it was decided to design a system which would operate on an existing up-and-over door. The result may not be as neat as a professional assembly, but the cost can be reduced by a substantial amount depending upon the type of motor selected.

To the electronics enthusiast, the circuits required to receive the ultrasonic signals from the car, process them, and start and stop the motor at the correct times are reasonably straightforward. The mechanics involved may seem complicated at first sight, but in fact, little specialised skill is required, and any person who is capable of fixing a shelf could tackle this project with confidence.

ULTRASONIC REMOTE CONTROL

The system to be described is intended for use on the rigid up-and-over type garage door and is based on having the door counterbalanced so as to be slightly biased towards opening.

An electric motor and gearbox combination then either permits the door to open by gradually releasing a cord or closes the door by winding the cord up again.

A solenoid is also incorporated to unlock the door.

The door can now be remotely operated from the driving seat of the approaching car with the use of an ultrasonic transmitter, the receiver mounted into the garage door frame. A push-button switch on the inside of the garage will close the door (or open it, should the motorist be taking the car out from the garage) once the car has been put away.

Various fail-safe mechanisms are included to prevent damage to the

car should the door close prematurely and to protect the motor in the event of the door being unable to close fully.

A block diagram of the electronic control is shown in Fig. 1.

SUITABILITY

The basic mechanics of automating a garage door are to be outlined first, since it is essential to establish the feasibility of the project, before building the circuits required. The whole project comprises of four main sections; the ultrasonic transmitter (fitted into the car); the ultrasonic receiver; the logic control circuit and the mechanics, including the door micro-switches and "safety cut-out circuit".

Each section is complete in itself, and some readers may find other applications for parts of the project. The logic circuit for example, is appropriate for any open/close, or up/down system from lifts to automated curtains!

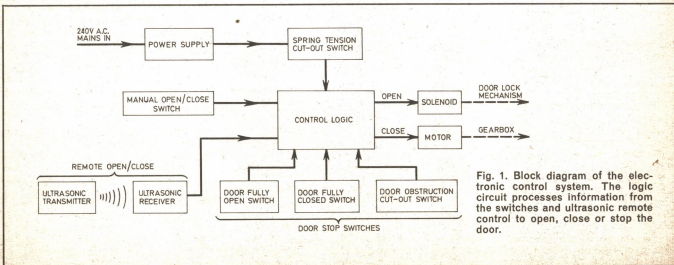


Fig. 1. Block diagram of the electronic control system. The logic circuit processes information from the switches and ultrasonic remote control to open, close or stop the door.

GARAGE DOOR

It is essential at this stage to check that the garage door can be closed and opened in the following way: (see Fig. 2). Unlock the door and pull gently in direction A. The door should begin to open, and it may rise under its counterbalance weights or springs. If it tends to stick, a vertical force in direction B should open it fully.

Now fix a cord to point P (to one side of the door) and pull down towards C, in direction of arrow. It should be possible to close the door fully, pulling only from point C.

If the door works in this way, it will be noted that only three forces are required to open and close the door. Force C is provided by the motor winding up a cord, force A is provided by a spring, and force B (if

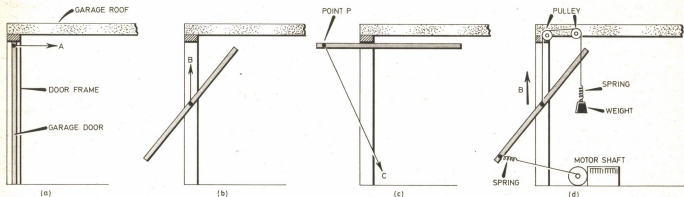


Fig. 2. (a), (b) and (c) show the forces required, and the directions in which they act, to open and close an up-and-over garage door (d) shows the way in which two of these forces are achieved.

necessary) by a weight and two pulleys as shown in Fig. 2(d).

The actual arrangement will vary according to the geometry of the garage, and detailed measurements will not therefore be provided. Before starting work, check that the door operates freely, and does not stick at any point. The importance of this cannot be over stressed.

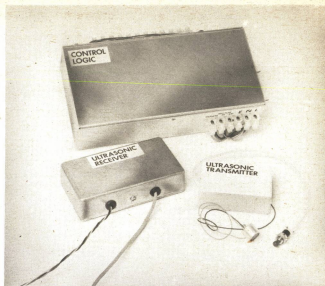
MECHANICAL ASSEMBLY

The actual construction and installation of the mechanics involved will be discussed in depth in Part Two of this article next month. The majority of the mechanical components, with perhaps the exception of the motor, should be readily available from builders merchants or hardware stores, or even scrounged from old scrap.

The ultrasonic receiver and transmitter circuits will be detailed first, each being treated as a separate unit. Part Two will deal with the Control Logic circuit construction, the mechanical modification and, finally, the fitting of the system as a whole to fully automate the up-and-over type garage door.

**CONTROL
ELECTRONICS
FOR THE
GARAGE
DOOR
SYSTEM**

**Electronics
Approx.
Cost
£42**



ULTRASONIC TRANSMITTER



The finished Ultrasonic Transmitter with remotely wired transducer and switch.

HAVING experimented with optical and infra red systems, an ultrasonic remote control system operating at 40kHz was chosen for its overall effectiveness regarding cost and

operating distance. Ultrasonic transducers are available in pairs (which in most cases means that either unit may be the transmitter or receiver) or sold as individual units, where the transmitting and receiving units are different.

Both combinations of these devices have been tried in the transmitter and the receiver, and little difference in performance was observed.

CIRCUIT DESCRIPTION

The circuit (see Fig. 3) is designed for operation from a nine volt battery. While the car battery supply could be used, the saving made hardly justifies the extra components required, especially when the life of the battery will probably approach the life of the car battery!

The transmitter is activated by pressing push button switch, S1, which must be held down for a few

ULTRASONIC TRANSMITTER

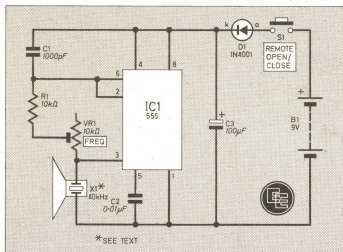


Fig. 3. Circuit diagram of the Ultrasonic Transmitter.

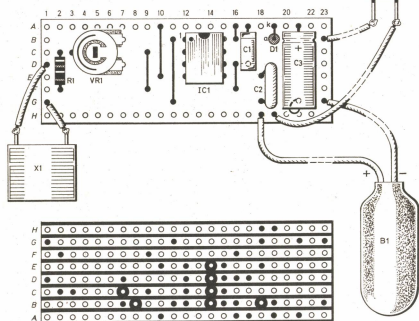
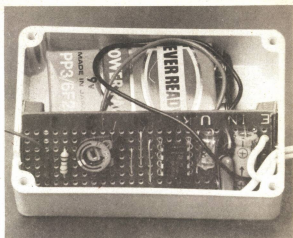


Fig. 4. Stripboard layout of the Transmitter, showing track breaks on the underside.



Transmitter with lid removed to show the way in which the board and PP3 battery are mounted.

COMPONENTS

TRANSMITTER

Resistors

- R1 10kΩ
¼W carbon ±5%

Capacitors

- C1 1000pF polystyrene
C2 0.01μF polyester
C3 100μF 25V elect.

Semiconductors

- IC1 555 timer
D1 1N4001

Miscellaneous

- B1 9V battery (PP3)
S1 push-to-make,
non-latching
VR1 10kΩ miniature
horizontal preset
X1 40kHz ultrasonic
transducer

Stripboard, 0.1 inch matrix, 8 strips by 23 holes; case size 72 x 50 x 25mm (Vero type 75-1469L); wire; battery clip; 8 pin d.i.l. i.c. holder.

See
**Shop
Talk**
page 30

COMPONENTS
approximate
cost £5.50

seconds (as determined by the preset VR2 in the receiver). The 40kHz signal required to drive the transducer, X1, is obtained from IC1, the popular 555 timer, in the astable multivibrator configuration functioning as an oscillator. The values of C1, R1 and VR1 are chosen to provide this frequency, VR1 being adjusted to ensure the maximum output is obtained from the transducer. Capacitor C2 also aids decoupling, and enhances stability. Capacitor C3 decouples the supply.

CONSTRUCTION starts here

CONSTRUCTION

A piece of 0.1 inch stripboard measuring 8 strips by 23 holes is used. In practice the size should be chosen to achieve a good fit in the case. See Fig. 4.

Break the tracks as shown (seven breaks altogether) and assemble the components, starting with the i.c. socket, wire links, and preset VR1. The other components should be added, checking the polarity of C3 and D1.

Decide at this stage where and how the device will fit inside the engine compartment of the car, and whether the transducer will be fixed by itself, or attached to the case of the transmitter unit. The transmitter should be mounted in a position where it can directly face the receiver, DO NOT FIT THE DEVICE TO THE CAR AT THIS STAGE, but establish the lengths of wire required to link the stripboard with the transducer and the push-button switch, S1.

Remember that this switch will be fitted below the dashboard and the wires must be long enough to reach the transmitter unit inside the car. Finally insert IC1 into its holder observing the correct orientation.

TRANSMITTER CASE

A small plastic case 72 x 50 x 25mm was used. Two holes, one for the transducer wires and the other for the push-button switch wires were drilled. The stripboard may be secured by means of self-adhesive foam rubber pads, and likewise the PP3 battery may be fitted. Holes for mounting the completed transmitter must also be drilled in the case.

The transmitter should be kept on the workbench ready for testing and tuning when the receiver has been constructed.

ULTRASONIC RECEIVER



The ultrasonic receiver is housed in a separate case to the power supply and control logic circuits. This reduces the chance of noise being picked up from the transformer, relays and motor, and allows the receiver to be placed near the receiving transducer thus avoiding the use of long connecting wires in this very sensitive area.

RECEIVER CIRCUIT DESCRIPTION

This circuit is based on an operational amplifier type 748, see Fig. 5. This is similar to the popular 741, but offers external frequency compensation, so with a suitable capacitor (C4) across pins 1 and 8, provides improved high frequency gain.

The signal from the transmitter is received by the transducer X1, is amplified by transistor TR1, and then

the output is applied to IC1 via coupling capacitor C2, the GAIN CONTROL pot, VR1, and capacitor C3. Resistors R5 and R6, and capacitors C5 and C6 form a filter which produces maximum gain at about 40kHz. This, together with the low values of C2 and C3 limits the sensitivity of the circuit at audio frequencies.

The output from IC1 is coupled via d.c. blocking capacitor C7 to the voltage doubler and detector diodes D1 and D2. When a 40kHz signal is received by the transducer, a steady voltage develops across capacitor C8. Resistor R8 is for discharging C8 under a no-signal condition.

When the signal is received, transistor TR2 switches on, its collector voltage falling almost to zero. Transistor TR3 is turned off, and the current flowing through VR2 and R10 flows via R11 to charge up capacitor C9.

COMPONENTS

RECEIVER

Resistors

R1	6.2M Ω
R2	100k Ω
R3, 4, 5	1M Ω (3 off)
R6, 7	1k Ω (2 off)
R8	82k Ω
R9	4.7M Ω
R10, 11	22k Ω (2 off)
All $\frac{1}{4}$ W carbon $\pm 5\%$	

Capacitors

C1	100 μ F 25V elect.
C2, 3, 5, 6	100pF ceramic (4 off)
C4	3.3pF ceramic
C7, 8, 10	0.1 μ F polystyrene (3 off)
C9	22 μ F 25V elect.

Semiconductors

IC1	748 operational amplifier 8 pin d.i.l.
D1, 2	OA91 germanium signal (2 off)
TR1, 2, 3	BC184L silicon npn (3 off)

Miscellaneous

VR1	47k Ω miniature horizontal preset
VR2	100k Ω miniature horizontal preset
X1	40kHz ultrasonic transducer

Stripboard, 0.1 inch matrix, 14 strips by 42 holes; diecast box size 113 x 63 x 31mm; small grommets (2 off); wire; screened cable; 8 pin d.i.l. i.c. holder; board mounting hardware.

COMPONENTS
approximate
cost £7.80

See
**Shop
Talk**
page 30

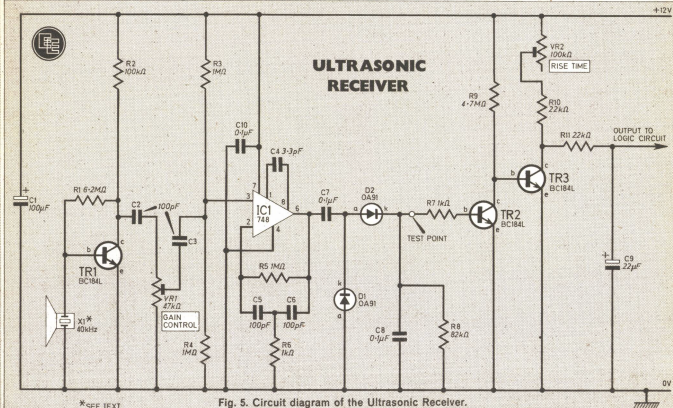


Fig. 5. Circuit diagram of the Ultrasonic Receiver.

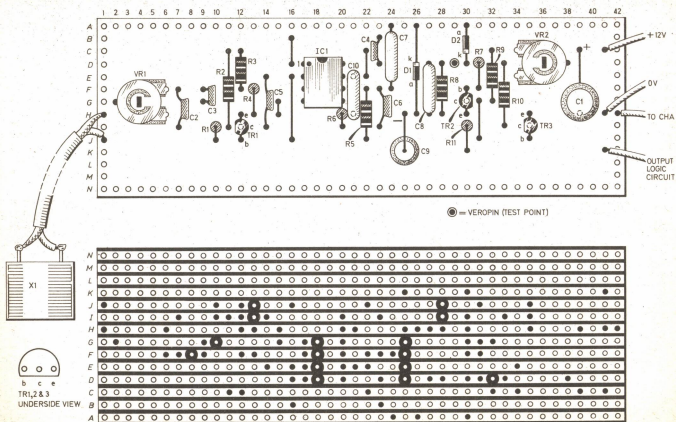


Fig. 6. Stripboard layout of the Receiver, the bottom view showing the positions of all track breaks.

Hence the voltage on C9 slowly rises, its charge rate determined to a large extent by VR2. Thus a steady signal lasting for a preset time must be received before the logic circuit of the next stage is triggered. This, together with the narrow band frequency selectivity of the amplifying stage makes the unit very insensitive to stray noise.

Under no signal conditions transistor TR2 is cut off, and enough current flows via resistor R9 into the base of TR3, turning it on, maintaining its collector at nearly zero volts, hence the current flowing via preset VR2 and R10 now sinks through TR3.

C9 will also be discharged through TR3, therefore no output is present under these conditions. Decoupling is provided by capacitors C1 and C10.

CONSTRUCTION starts here

CONSTRUCTING THE RECEIVER

The receiver is constructed on 0.1 inch matrix stripboard measuring 42 holes by 14 strips (see Fig. 6).

Break the tracks where shown (15 in all) and solder in the wire links, i.e. socket, presets VR1 and VR2, and resistors. The diodes, electrolytic capacitors and transistors must be fitted the correct way round, the non-polarised capacitors can be fitted either way. The i.c. may now be inserted, again observing the correct orientation.

Finally solder the connecting wires and screened cable to the ultrasonic

detector, ensuring that the screen connects the case pin of the detector with the 0V track on the circuit board. Note also that this lead will have to be threaded through the case of the receiver, and through the hole in the garage door frame (yet to be drilled).

DIECAST CASE

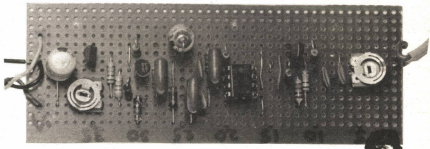
In order to provide electrical screening, a diecast box should be used to house the receiver circuit. The box used in the prototype measured 113 x 63 x 31mm.

Begin by drilling holes for the earthing screw, securing screws, transducer lead and output/power leads. Rubber grommets should be fitted where any leads pass through

Connect a voltmeter set to read about 5 volts between the TEST POINT at D2 "k" and 0 volts on the receiver. Set up the transmitter and the receiver with the two transducers facing each other, a few centimetres apart.

Adjust the transmitter preset, VR1, to about the half way point, and set the receiver preset VR1, GAIN CONTROL, to full gain, that is fully clockwise.

Switch on the receiver 12V power supply, and observe the voltmeter. It should read zero. Connect the transmitter power supply (PP3 battery) and check that the voltmeter now gives a reading when transmitter switch, S1, is made. Adjust the transmitter preset, VR1, if necessary to obtain a maximum reading.



Finished Receiver board assembly.

the case, and the stripboard may be mounted by any convenient method, taking care not to allow the case to cause a short circuit.

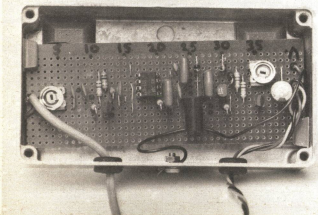
Finally the lead from the 0V track (marked CHASSIS on Fig. 6) should be fixed to the case by means of a solder tag connection.

TESTING THE ULTRASONIC SYSTEM

A 12V power source is necessary to test the receiver as the power supply on the control logic circuit has yet to be built.

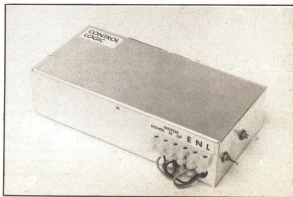
Move the transducers much further apart (up to 10 metres), and again adjust the transmitter preset for a maximum reading.

Reset the voltmeter to read 12V, equal to the power supply, and connect the positive meter terminal to the "output" lead from the receiver. Set VR2, RISE TIME control, to a midway position, and switch on the transmitter. The voltmeter reading should slowly rise to nearly the supply voltage, and fall to zero when the transmitter is turned off. Adjusting VR2, will alter the time taken for the voltage to rise, thus setting the delay time before the control logic is activated.



View inside the Receiver case showing the component board with screened cable to the transducer.

NEXT MONTH: LOGIC CONTROL AND MECHANICAL ASSEMBLY



MODEL TRAIN CHUFFER

BY R. A. PENFOLD

MODEL railway layouts can be fitted with numerous accessories to give greater realism, and this does not just include items which give improved realism visually. Various sound effects units for model railways can be produced, and the "chuffer" unit described here is an example of such a unit.

When the model train is stationary the unit produces a "hissing" sound (to feed on amp/speaker) which simulates the sound of a steady stream of steam escaping from a stationary locomotive. When the train starts to move, the "chuffing" sounds are produced, and the unit responds to the track voltage so that as the speed of the train increases and decreases, so does the "chuffing" rate.

The unit can be adjusted so that the "chuff" sounds commence as the train starts to move.

The unit does not have an integral amplifier or loudspeaker, and is intended to feed into a hi fi system, record player, or any suitable amplifier. Best results seem to be obtained with a fairly high power amplifier and a large speaker, but quite good results can be obtained using a simple battery powered amplifier having an internal miniature speaker if preferred.

This chuffer unit should work with any normal type of train controller without any modifications being required. It will operate with types that have an unsmoothed or pulsed output just as well as with types having a smoothed output.

SYSTEM PRINCIPLES

Consider the block diagram of Fig. 1.

The voltage across the track is fed to the control input of a voltage controlled oscillator, and the latter is de-

signed so that it fails to operate with a low input voltage, and has an operating frequency that rises steadily as the input voltage is increased above a certain threshold level. It is this oscillator that sets the "chuff" rate.

With many controllers the voltage on the track is not a steady d.c., but is simply a rectified a.c. signal, or a series of pulses. In either case the motor responds to the average d.c. potential across the tracks, and the voltage controlled oscillator must also be designed to respond to the average level, rather than the level present from one instant to the next.

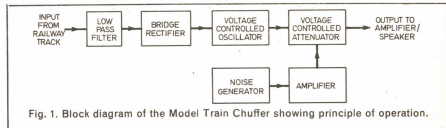


Fig. 1. Block diagram of the Model Train Chuffer showing principle of operation.

This is achieved simply by adding a low pass filter at the input to integrate the pulses and give a reasonably smooth d.c. output. This also filters out any noise spikes placed on the track supply by the electric motor in the locomotive.

BRIDGE CIRCUIT

The voltage controlled oscillator must also respond properly to an input voltage of either polarity since the direction of the train is controlled by switching the polarity of the track supply, and both polarities will be used. This problem is easily overcome by adding a bridge rectifier at the input so that the polarity of the signal fed to the control input of the voltage controlled input is always the same, regardless of the track supply polarity.

A white noise generator produces a "hissing" sound which is very similar to the sound of escaping steam, and a noise generator is therefore used to produce the basic signal of the chuffer. The output of the noise generator is quite weak and it is therefore amplified before being applied to a voltage controlled attenuator. From here the signal is fed to the output.

HISS AND CHUFF

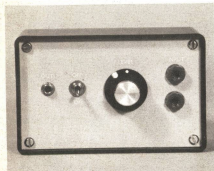
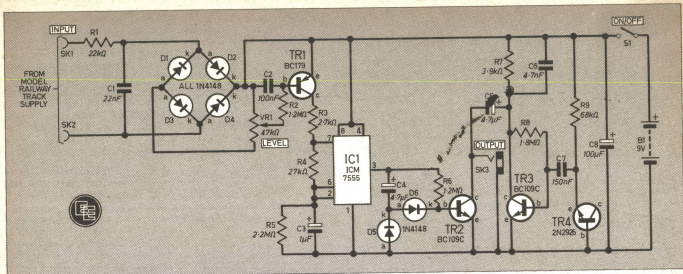
The voltage controlled attenuator is controlled by the output signal of the voltage controlled oscillator. The circuit is arranged so that with the voltage controlled oscillator not operating, the noise signal is moderately attenuated, and produces a reasonably strong output signal. This is the required steady "hissing" sound of a stationary steam locomotive. When the voltage controlled oscillator starts to operate it switches the voltage controlled attenuator between full output and zero output, so that bursts of noise are produced at the output and the desired "chuffing" sound is generated.

CIRCUIT DESCRIPTION

Now consider the circuit diagram, Fig. 2. R1 and C1 form the low pass filter at the input and D1 to D4 form the bridge rectifier. The voltage controlled oscillator is based on TR1 and IC1, the latter being a CMOS 555 timer i.c. (the ICM7555) used in the astable mode. The CMOS version is used here merely because it gives the circuit a much lower current consumption (around 2mA instead of 10mA).

With no input voltage to the unit TR1 will be switched off and there is no charge path for timing capacitor C3. The oscillator therefore fails to operate. With a track voltage of reasonable proportions present, TR1 is biased into conduction by way of R2 and oscillations are produced. The higher the track voltage, the more heavily TR1 conducts, and the higher the frequency of oscillation. VR1 is adjusted so that oscillation commences at the appropriate track voltage.

R5 is included in the circuit to prevent the oscillator from operating at a very low frequency due to possible leakage through TR1, which could produce the occasional "chuff" while the train was stationary.



The prototype Chuffer before labelling of control panel functions.

WHITE NOISE

The noise signal is generated by R9 and TR4. The base-emitter junction of TR4 is reverse biased and acts rather like a low voltage Zener diode. Like a Zener diode it produces noise spikes which collectively give the required white noise signal, but this signal is only a few millivolts r.m.s. in amplitude and must be considerably amplified in order to give a high enough output level to drive most amplifiers. The necessary amplification is provided by TR3 which is used as a straightforward high gain common emitter amplifier. C6 rolls off the amplifier's audio response of this stage slightly. This is necessary because the pitch of the noise signal is slightly too high to give a realistic effect. C5 couples the amplified noise signal to the output socket.

TR2 has its collector to emitter impedance shunted across the output of the unit, and the output signal level can be controlled by means of a signal to the base of TR2. With zero base current, TR2 is switched off and has such a high collector to emitter impedance that it has no significant effect.

If it is steadily biased more heavily into conduction it gradually loads the output more heavily, thus reducing

the output level. When biased hard into conduction the output level is insignificant.

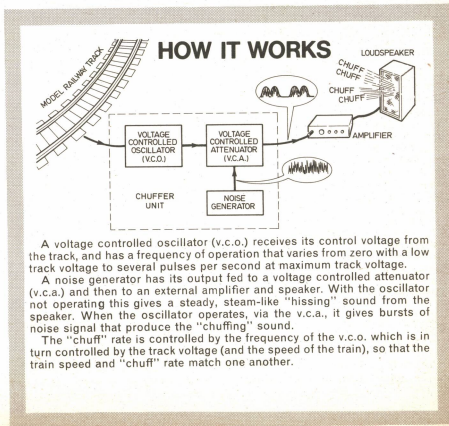
Of course, a simple voltage controlled attenuator of this type would not be acceptable in most applications as it generates significant amounts of distortion, but here it is only being used to control a noise signal and quite high levels of distortion are of no consequence.

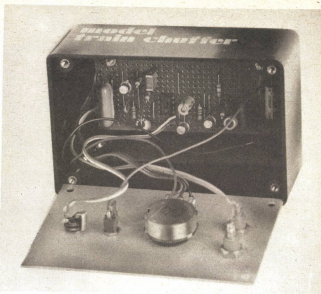
When IC1 is not oscillating, its output assumes the high state. TR2 is then biased into conduction from the output of IC1 via R6, but it does not conduct very heavily and there is a reasonably strong noise signal at the output.

When IC1 is oscillating, on positive output pulses a strong base signal is applied to TR2 by way of C4, D5, and D6. This reduces the amplitude of the output signal to practically zero.

When the output is negative, TR2 does not receive any significant bias current through R6, or C4, D5, and D6, so that it switches off and the output is at full amplitude. Thus the required modulation of the output signal and the "chuffing" sound is produced.

The circuit gives an output signal level of sound around 1 volt r.m.s. from a 3.9k Ω source impedance, and this is sufficient to drive any normal audio amplifier.





View of the Chuffer with lid raised showing board mounted on rear of case.

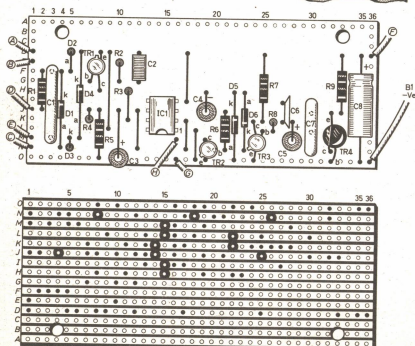
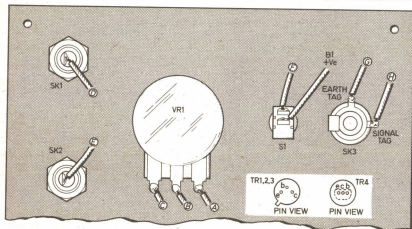


Fig. 3. Layout of the components on the stripboard with breaks to be made on the underside. Also shows wiring between board and case mounted components.

COMPONENTS

Resistors

- R1 22kΩ
- R2 1-2MΩ
- R3 2-7kΩ
- R4 27kΩ
- R5 2-2MΩ
- R6 1-2MΩ
- R7 3-9kΩ
- R8 1-8MΩ
- R9 68kΩ

All ½ watt carbon ± 5%

Capacitors

- C1 22nF polycarbonate
- C2 100nF polycarbonate
- C3 1μF 25V elect.
- C4 4-7μF 25V elect.
- C5 4-7μF 25V elect.
- C6 4-7nF ceramic plate
- C7 150nF polyester (C280)
- C8 100μF 10V elect.

Semiconductors

- IC1 ICM7555 CMOS timer i.c.
 - TR1 BC179 silicon pnp
 - TR2,3 BC109C silicon npn (2 off)
 - TR4 2N2926 silicon npn
- (see text)
- D1 to D6 1N4148 small signal silicon (6 off)

Miscellaneous

- VR1 47kΩ carbon lin. law potentiometer
 - S1 s.p.s.t. miniature toggle
 - SK1,2 Wandler sockets (2 off)
 - SK3 3-5mm jack socket
 - B1 9V type PP3
- Stripboard: 0-1in matrix, 15 strips × 36 holes; case type BIM4004 or similar; control knob; p.v.c. covered stranded wire; output leads, 3-5mm jack plug to connectors to suit amplifier.

Approx. cost
Guidance only **£7**

CONSTRUCTION starts here

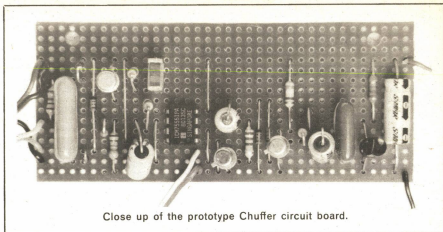
STRIPBOARD LAYOUT

The chuffer unit can be made quite compact and it will readily fit into a case measuring about $110 \times 70 \times 50$ mm. The controls and sockets are mounted on the front panel, and any sensible layout can be employed as the layout is not critical from the electronic point of view.

The stripboard layout for the circuit is shown in Fig. 3, and uses 0.1 inch matrix board having 15 strips by 36 holes. There are thirteen breaks in the copper strips plus the two GBA or M3 clearance mounting holes to be made before soldering in the components and link wires.

IC1 is a CMOS device, but it has an internal protection circuit that eliminates the need for any of the usual CMOS handling precautions. It can therefore be soldered direct to the board and it is by no means essential to use an i.c. socket.

TR4 is a 2N2926 device in the prototype, but any silicon *npn* device having a low base/emitter reverse breakdown voltage should work just as well. Devices such as a 2N2924, 2N3711, 2N3708, BC184, and a BC238 all worked well in the circuit, and it is likely that most constructors will be able to find a suitable device in their spares box.



Close up of the prototype Chuffer circuit board.

Devices having a comparatively high reverse base/emitter breakdown voltage will not work properly in the circuit as the battery voltage might be inadequate to produce breakdown and generate the noise spikes, especially as the battery voltage starts to fall.

The completed component board is wired to the rest of the components once fitted on the front panel using ordinary multistrand p.v.c. insulated wire, and the board is then mounted on the rear panel of the case, towards the top, using M3 or 6BA fixings. This will leave ample space for a PP3 size 9 volt battery on the base of the case, and a piece of foam material can be used to keep the battery in position here.

USING THE UNIT

A screened lead fitted with plugs of the appropriate type is used to connect the output of the chuffer unit to the input of the amplifier. An or-

dinary twin lead is used to take the voltage from the track to SK1 and SK2, and an extra power rail can be included in the layout to provide a convenient take-off point for the track voltage.

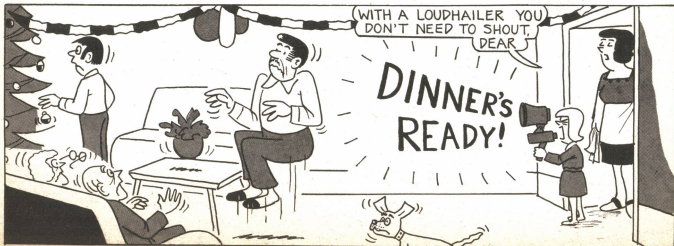
Probably the easiest way of giving VR1 the correct setting is to adjust the train controller so that the train is moving as slowly as possible, and then adjust VR1 for the lowest possible "chuff" rate. After using the unit for a while, any fine trimming of VR1 can then be carried out if it should prove necessary.

VR1 has been made a panel control rather than an internal preset component so that it can easily be re-adjusted to suit a different locomotive.

If the amplifier has tone controls it is worthwhile experimenting a little with the settings of these to try to obtain optimum realism. A certain amount of bass boost, for example, can give a very good effect. □

JACK PLUG & FAMILY...

BY DOUG BAKER



EE

PART 4

BY O.N. BISHOP

TEACH-IN 82



BASIC ELECTRONIC THEORY WITH EXPERIMENTS

SWITCHING CIRCUITS WITH TRANSISTORS AND INTEGRATED CIRCUITS

SO FAR we have studied the action of three kinds of electronic component:

(1) **Resistors** reduce the flow of electric current by a greater or lesser amount, depending on their resistance.

(2) **Diodes** allow current to flow freely in one direction but allow virtually no current to flow in the opposite direction.

(3) **Transistors** have two actions: (i) they act as switches, allowing a current to flow or not to flow, (ii) they act as variable resistors allowing different amounts of current to flow. The varying flow of current is itself controlled by a much smaller current, so transistors acting in the second way are amplifiers.

Components such as transistors and diodes, which give a gain in current or voltage, or which have directional properties, are called **active components**. Components such as resistors, which do not have these effects, are called **passive components**.

This month we shall follow one important way of using the switching property of transistors.

EXPERIMENT 4.1

The action of a switching transistor

Fig. 4.1 shows a transistor (TR1) connected so as to switch an l.e.d. (D1) on or off. The Verobloc layout for this experiment is shown in Fig. 4.2.

Touch flying lead X to strip A (+6V). This turns TR1 on. It now has very low resistance between d and s (about 5 Ω). If we think of TR1 and R4 as parts of a potential divider, we can calculate that the voltage at point Z is about $6 \times (5/185) = 0.16V$. This is close to 0V, and certainly not high enough to cause a current to flow through the l.e.d. and light it.

Touch X to strip M (0V). This turns TR1 off and its resistance is several million ohms. The voltage at Z becomes almost +6V. A current can now flow through D1.

Check the truth of the statements above by connecting the meter to Z (location F18).

EXPERIMENT 4.1

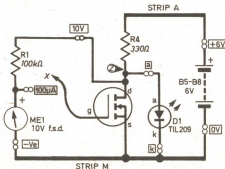
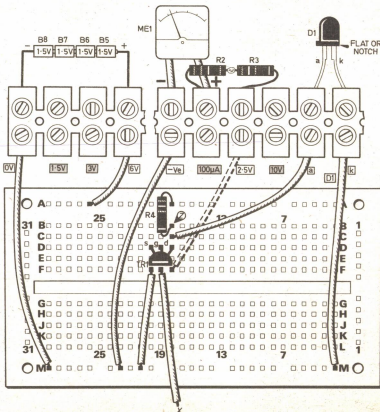


Fig. 4.1. Circuit diagram for investigating the switching action of a VMOS transistor.

Fig. 4.2. The layout of Fig. 4.1 on the Verobloc. The dotted leads show the connections for measuring the voltage at Z.



TRUTH TABLES

We can summarise the results of Experiment 4.1 in a table. In this table (Table 4.1) the word "low" means 0V or as close to 0V as makes no difference. The word "high" means the supply voltage (+6V in this experiment) or close to it. The second column shows the voltage at Z that corresponds to any given voltage at X. This table is a **truth table** because it tells us what is true about the logic of the circuit.

Table 4.1

X	Z
Low High	High Low

Table 4.2

X	Z
0	1
1	0

Table 4.2 shows exactly the same thing, but represents low by "0" and high by "1". It is a little quicker to write Table 4.2 and to read from it.

Notice that X and Z can have only two states—low or high, 0 or 1 respectively. This is because the transistor is either on or off. We do not allow in-between states.

If X is 0, Z is 1. We could also say that if X is 0, Z is NOT 0. Or if X is 1, Z is NOT 1. This circuit performs a simple logical operation. Z is always the opposite of X . Z is NOT X . The logical operation is therefore called NOT. Sometimes it is called INVERT.

A circuit which performs a logical operation is called a **logic gate**. Note that this use of the word "gate" is different from its use for the gate electrode of an f.e.t.

Fig. 4.1 thus shows the circuit of a NOT gate, with input X and output Z . The l.e.d. is not part of the gate; it is there simply to show the state of the output of the gate.

EXPERIMENT 4.2

Diode gates investigated

Two diodes are used in the logic gate shown in Fig. 4.3. As before, the i.e.d. (DI) indicates the state of the output (Z). Inputs *X* and *Y* can each be made 1 (=6V) or 0 (=0V). Since there are two inputs, each with two possible states, there are four possible combinations of inputs. The truth table for this gate needs four lines:

Table 4.3

Inputs		Output
X	Y	Z
0	0	
0	1	
1	0	
1	1	

The output column has been left blank, for you to fill in the results of your experiment. The layout for this is shown in Fig. 4.4. The results appear on p.29.

When you have finished the above test, work out the behaviour of the gate in Fig. 4.5. Verobloc layout Fig. 4.6.

The input columns of the truth table are the same as in Table 4.3, but the outputs are different (see p.29 for answer).

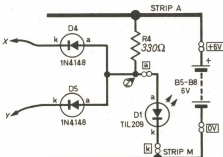
AND and OR

The output of the gate in Fig. 4.3 can be high only if both *X* AND *Y* are connected to 6V. If either *X* or *Y* are connected to the 0V rail, current flows through D4 or D5, which act as resistors of low value. The voltage at *Z* becomes close to 0V.

Since both X AND Y must be 1 to obtain an output of 1, we call this an AND gate. Z is true ($Z=1$) only when X is true ($X=1$) AND Y is true ($Y=1$).

In Fig. 4.5 the output is 1 whenever X or Y are connected to +6V. Connecting either to 0V has no effect, since the diodes do not allow current to flow from Z to the

EXPERIMENT 4.2



You will notice in this and the remainder of the Experiments this month, that no current limit resistor appears in series with the l.e.d. This is in order when operating from a low supply voltage but one must be included when the supply voltage is greater than 6V.

Fig. 4.3. Circuit diagram for investigating diode gates.

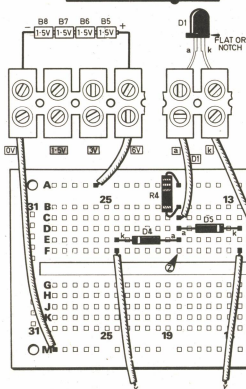


Fig. 4.4. The layout of Fig. 4.3 on the Verobloc.

EXPERIMENT 4.2

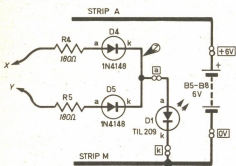
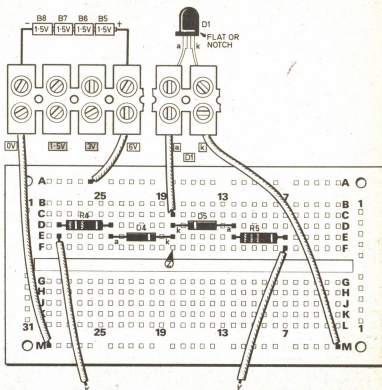


Fig. 4.5. Another circuit for investigating diode gates. Compare orientation of D4 and D5 with those in Fig. 4.3.

Fig. 4.6. The layout of Fig. 4.5 on the Verobloc. Take care to orientate the diodes correctly.



EXPERIMENT 4.3

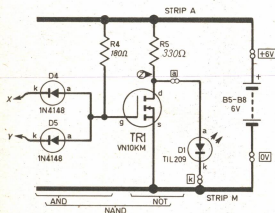
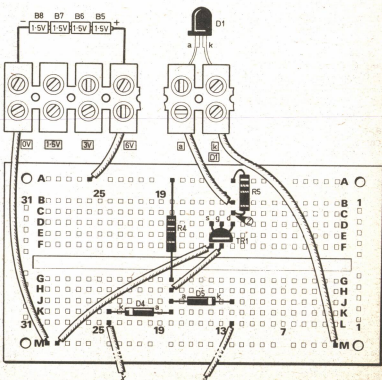


Fig. 4.7. Circuit in which an AND gate and a NOT gate are cascaded to form a third type of logic gate.

Fig. 4.8. The circuit of Fig. 4.7 wired up on the Verobloc.



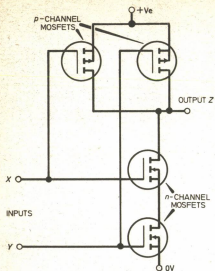


Fig. 4.9. Making a NAND gate from four mosfets.

INTEGRATED CIRCUITS

Another way of making a NAND gate is shown in Fig. 4.9. It is made from four MOSFETS. Two of these are *n*-channel MOSFETS, such as we described in Part 2. They are switched on when their gate electrodes are made high. The other two transistors are *p*-channel MOSFETS, which are switched off by a high input, but turned on by a low one.

To give a low output at Z we need to turn both n -channel transistors on (connecting Z to the 0V rail), and turn both p -channel transistors off (isolating Z from the +6V rail). In other words, inputs X and Y must both be high. With any other combination of inputs, Z is connected to the 6V rail through one or both of the p -channel transistors: also, one of the n -channel transistors is off, disconnecting Z from the 0V rail. In all these cases, output is 0.

Such a gate has a much faster and more reliable action than the simple gates used in the experiments. We could make such a gate by wiring up four MOSFETS on the breadboard, but there is no need to go to this trouble and expense, for the gates can be bought ready-made.

When manufacturing MOSFETs it is easy to produce several on a single slice of silicon complete with the connections needed make up the logic gate. This is what is called an **integrated circuit**.

In this example, we find four NAND gates on a single chip, as shown in Fig. 4.10. Each gate has two input terminals and one output terminal. They share a common power supply. The package is described as a quad 2-input NAND.

When we are building logic circuits it is not necessary to know exactly how each gate is constructed. All we need to know is *what it does*. Consequently it is much simpler and a good deal more informative if we represent gates by special symbols, see Fig. 4.11.

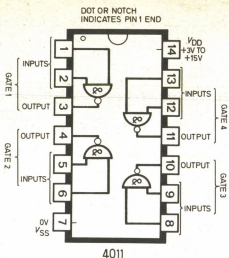


Fig. 4.10. Pinning details for the CMOS Quad-2-input NAND gate i.c., 4011. Viewed from above.

Note that some kinds of gate may have more than two inputs; NOT gates always have one input and EXCLUSIVE-OR gates always have two.

EXPERIMENT 4.4

Logic with integrated circuits

Fig. 4.12 shows how to test one of the gates of the 4011 i.c. The unused inputs of

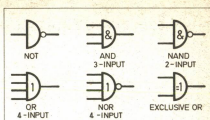


Fig. 4.11. Symbols for logic gates.

the other gates are connected to +6V; if this is not done the i.c. does not work properly. Run through the input combinations of Table 4.3 and check that the gate performs the NAND function properly. The layout for this experiment is shown in Fig. 4.13.

Next wire both inputs of the gate together (connect *Y* to *J20*). This makes the gate into a one-input gate. What logical operation does it perform now? (see p29).

Wire up the circuits of Fig. 4.14a and b. The numbers indicate the pins to be used on the pins being numbered as in Fig. 4.10. Run through the usual four input combinations for each circuit. What logical operations do these circuits perform? It appears that NAND gates can be made to do many different jobs.

Remove the +6V battery lead from the Verobloc, and replace the 4011 by the 4070 i.c. and then re-connect the +6V supply

EXPERIMENT 4.4

Fig. 4.12. Circuit for investigating the action of a 2-input NAND gate, one of the four contained in a 4011.

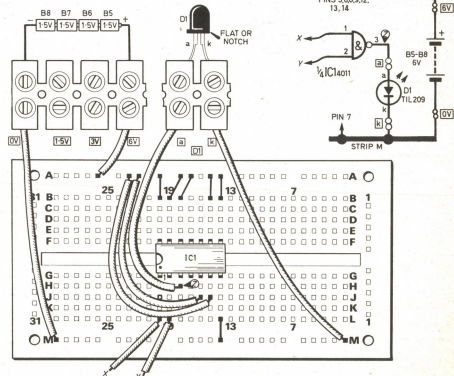


Fig. 4.13. The layout of Fig. 4.12 on the Verobloc. Note that unused inputs are strapped to +6V.

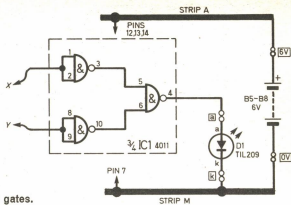
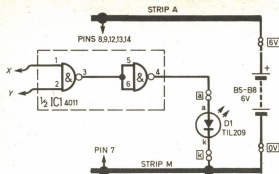


Fig. 4.14 (a) and (b) (right). Making logic modules from NAND gates.

EXPERIMENT 4.5

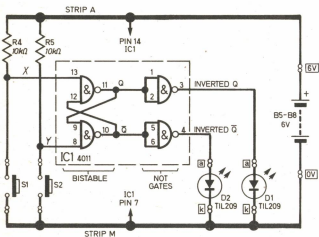
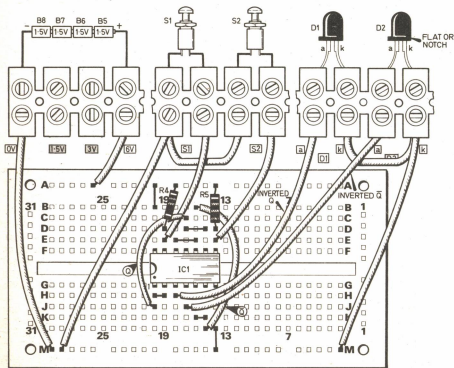


Fig. 4.15. Making up a bistable from two NAND gates. The other two gates are used as buffers.

Fig. 4.16 (below): The Verobloc layout for the circuit in Fig. 4.15.



lead. This i.c. has four EXCLUSIVE-OR gates. Each has two inputs, the pin connections are the same as those of the 4011, but the logic function is different. Find its truth table (see p29 for answer).

COMPUTER LOGIC

Logic gates are the basis of the action of many kinds of device, from the pocket calculator and electronic door-chime to the most elaborate of mainframe computers. Mathematics operates by logical rules so we use logic circuits for all kinds of calculations. There is more to say about this in Part 12 of the Series.

EXPERIMENT 4.5 A memory circuit

Two NAND gates can be cross-connected (Fig. 4.15) to form a **bistable** circuit. It gets its name because it has *two* stable states. We cannot connect I.e.d.s directly to the outputs of this circuit for they take so much current that the bistable does not operate. So we feed the outputs to two NOT gates and use these to drive the I.e.d.s, D1 and D2. The inputs are normally held high by the pull-up resistors R4 and R5. They can be made low by pressing S1 or S2.

The layout of the components on the Verobloc for this experiment is seen in Fig. 4.16. When the battery is first connected, one, *but not both*, of D1 and D2 will light. Find out which button you have to press to make the bistable change state. How do you make it change back again? If you press the same button again, what happens? Figs. 4.17 a, b and c explain this.

If the buttons are pressed alternately the bistable repeatedly changes from one state to the other and back again. On a low input at X it flips from one state to the other, then on the next low input at Y it flips back again. This type of bistable is often called a **flip-flop**.

The state it is in at any moment is determined solely by which input was the last one to be made low. It can "remember" what has happened to it in the past. The flip-flop is used in calculators and computers as a way of storing information—a unit of memory.

EXPERIMENT 4.6

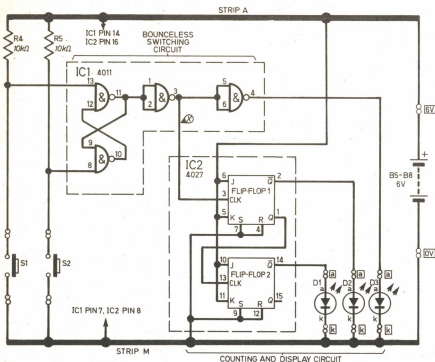


Fig. 4.19. A counting circuit using two J-K flip-flops, a bistable and two NOT gates.

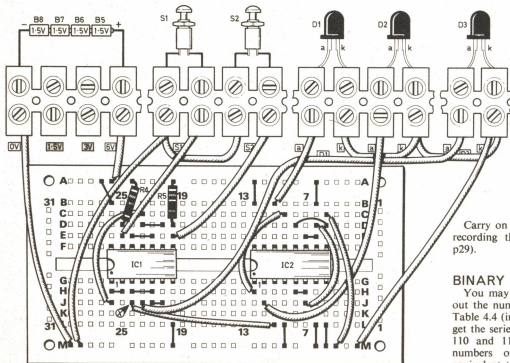


Fig. 4.20. The layout of Fig. 4.19 on the Verobloc.

press S2 to give a low-to-high change (changes the J-K flip-flop). Press S1 and S2 alternately until all l.e.d.s are out. Now we are ready to start.

Press S1, making D3 light. The high-to-low change at X does not affect the J-K flip-flops. Press S2, making D3 go out. The low-to-high change at X makes FF1 (flip-flop number one) change state and D2 lights. The Q output of FF1 changes from high to low, so it has no effect on FF2 and D1 stays out. Now press S1 again. D3 lights, but there are no other changes, so both D2 and D3 are now lit.

At the next press of S2, D3 goes out and so does D2, for there is a low-to-high change at X. As Q of FF1 goes low, Q goes high; this triggers FF2 to change state. D1 comes on for the first time.

The changes so far can be set out in a table:

Table 4.4.

Step No.	Press	D3	D2	D1
0 (start)	—	0	0	0
1	S1	0	0	1
2	S2	0	1	0
3	S1	0	1	1
4	S2	1	0	0

0 = unlit; 1 = lit

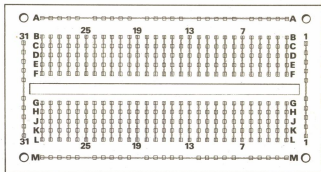
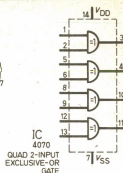
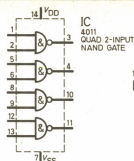
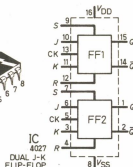
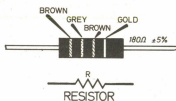
Carry on as above for four more steps, recording the results as above (answers p29).

BINARY SCALE

You may have noticed that if we write out the numbers in the diode columns of Table 4.4 (including your own results), we get the series 000, 001, 010, 011, 100, 101, 110 and 111. These are the first eight numbers on the binary scale, being equivalent to counting from 0 to 7 in the decimal scale. On the eighth press the lamps all go out, returning the count to 0.

This circuit demonstrates how flip-flops can be used to count. It counts the number of presses on the buttons. Similar circuits can be used to count electrical pulses from other sources. If the pulses are produced by cars going into a car-park, we can use such

TEACH-IN 82 COMPONENTS IDENTIFIED



a circuit to count the cars, and to trip a flip-flop to switch on a 'Park Full' sign when the maximum number is reached. Counting circuits are widely used in all kinds of situations and most of them are based on chains of flip-flops.

Since there have been so many questions in the Experiments there is no *Question Time* this month. Next month we look at some other kinds of transistor and see what they can do.

Answers to this month's Experimental Exercises.

EXPERIMENT 4.2

Truth table for AND

Inputs	Output
X Y Z	
0 0	0
0 1	1
1 0	1
1 1	1

Truth table for OR

Inputs	Output
X Y Z	
0 0	0
0 1	0
1 0	0
1 1	1

EXPERIMENT 4.4

When the two inputs of a NAND gate are wired together, it functions as a NOT gate (see 1st and 4th lines of your NAND table).

Fig. 4.14a. Inverting the output from a NAND gives NOT-NOT-AND, which gives AND.

Fig. 4.14b. Inverting the inputs to a NAND gives OR.

Truth table for EXCLUSIVE-OR

Inputs	Output
X Y Z	
0 0	0
0 1	1
1 0	1
1 1	0

Z is high when one of X or Y (but not both) are high.

EXPERIMENT 4.6

The remaining stages are:

Step No.	Press	D3	D2	D1
5	S1	1	0	1
6	S2	1	1	0
7	S1	1	1	1
8 (=0)	S2	0	0	0

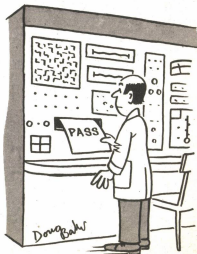
ERRATA

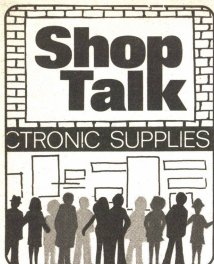
Further to the correction last month concerning Fig. 1.3, on p660 lines 13 and 21: change X to Y.

In Question 1.10, "R1 = 150kΩ and R2 = 150Ω" should read "R4 = 150Ω and R5 = 150Ω".

PART 3 ANSWERS

1. n-type.
2. Cathode.
3. Holes (and positive ions in solution).
4. 0.6V.
5. No.
6. By the depletion region.
7. Out.
8. It draws virtually no current from the circuit under test.
9. 2.7V.
10. 1.72V.





By Dave Barrington

Component Packs

The recommendation of bargain packs of components is very subjective and really a case of one's own personal experience as to whether they are "value for money". Our own experience has been that certainly for such items as resistors, capacitors, diodes and mixed semiconductors buying packs is cost saving and to be recommended.

When you consider that resistors can cost from 1 to 3p each and that you can purchase packs of 100 to 600 resistors, of varied values, from the sum of 90p to under £6 this is quite a saving. On the other hand, the purchase of a mixed selection of "untested" semiconductors has been known to show a 30 per cent failure rate.

Two kits worthy of closer investigation are the E12 series of resistor packs from Home Radio and Rapid Electronics.

A feature of the Home Radio SP22 Resistor Pack is the method of packing the resistors in compartmented cardboard trays with their values indicated on label strips. This makes for easy selection.

With 10 each of the popular values and 5 each of the less popular, the pack contains approximately 400 resistors and costs £5 including VAT and postage.

The Rapid kit contains 650 1W 5 per cent carbon film resistors banded together in groups of ten. The values range from 4-7 ohms to 1 megohm.

The cost of the Rapid Electronics kit is £4-80 plus VAT and 50p postage and packing.

Pocket Music Tutor

Of the thousands of electronic organs and pianos sold every year, it is claimed that three quarters are bought by people with no knowledge of music. However, they've all got something in common: they all want to get recognisable tunes out of their instruments as soon as possible.

Budding organists and pianists struggling through the first stages of learning

to play will welcome the pocket electronic chord and scale tutor from Speedyplain.

Called Prelude, it gives an instant visual guide to more than 600 chords as well as all major and minor scales. It's a hand-held device, similar to a pocket calculator, with keys for the musical notes, chords and inversions, and a liquid crystal key-board display.

The unit is designed to help tutored or self-taught students learn the basic "alphabet" of music; to teach classically trained musicians modern harmony and to help string or wind players to convert to keyboards.

Two professional organ teachers who helped in Prelude's design claim it is far easier and quicker to use than a printed tutor. Not only does it show notes making up the basic chord, but the user can add progressively more complex components, such as sixths, sevenths, ninths, minors and diminisheds.

The Prelude tutor is available direct from Speedyplain Ltd., Dept EE, 120 Marsh Lane, Longton, Preston, PR4 5YL, and cost £19-95 including VAT (without batteries), plus 40 pence post and packing.



The Prelude electronic chord and scale tutor from Speedyplain.

Project Kits

After a successful campaign in Europe, Velleman electronic kits are now available in this country through Velleman UK Ltd.

Ranging in price from £4 to about £250, a fairly wide selection of kits are offered to satisfy the beginner and the advanced constructor. They range from a simple three-tone bell to a microprocessor controlled Eprom programmer.

Each kit is given a "degree of difficulty" grading to help would-be constructors to select kits within their capability. All kits are built on printed circuit boards with component designations printed on the topside.

Copies of a free illustrated catalogue containing details of the range of Velleman electronic kits is obtainable from Velleman UK Ltd., Dept EE, P.O. Box 30, St Leonards on Sea, East Sussex, TN37 7NL. A stamped addressed envelope would be appreciated.

Catalogue

The new Tandy 1981/2 catalogue is now available in all 300 Tandy stores throughout Britain. Issued free to all Tandy customers, the 140 page catalogue contains over 2200 exclusive own brand products.

The catalogue also includes a ten page section on all hardware, software, peripherals and for the TRS-80 microcomputer, Models I, II and III, the TRS-80 pocket computer and the very latest Colour Computer.

CONSTRUCTION PROJECTS

Automatic Garage Doors

The 40kHz transducers used in the transmitter and receiver units for the Automatic Garage Door are fairly common items and now stocked by most component suppliers. These are usually sold in pairs and may be supplied with two-pin or phono plug connections. Either type may be used but the latter will require altering the wiring to the transducers.

The motor used in the designers set-up was a Fracmo type, currently stocked by Service Trading Co. Dept EE, of 57 Bridgman Road, Chiswick, London, W4 5EB, with an output shaft running at approximately 56r.p.m. and a more than adequate torque of 50lbs/in. We understand that they have only a limited stock, but are able to supply a near equivalent type in their Parvalux range with 42 or 30 r.p.m. at 50lbs/in. torque.

The author informs us that a cheaper alternative would be two one-way motors fitted together in such a way as to enable reverse operation.

Most of the hardware for the door gear should be available from local builders merchants or hardware stores.

Mini Egg Timer

Because of the close packing of components within the small case for the Mini Egg Timer, the audible warning device WDT specified should be used.

This is available from Ambi International as stock number 43-27201. However, any low voltage (6V) solid state buzzer could be used here but would necessitate a larger case or be mounted on the exterior of the case.

Model Train Chuffer

The Model Train Chuffer uses a CMOS equivalent to the renowned 555 timer i.c. This is designated ICM7555 and appears to be available from most advertisers, at a price varying from 80p to just over £1.

Siren Module

Once again it may be wise to browse through the advertisements when looking for a particular component for the Siren Module. The transistor type TIP31A is listed from 40p to 52p each.

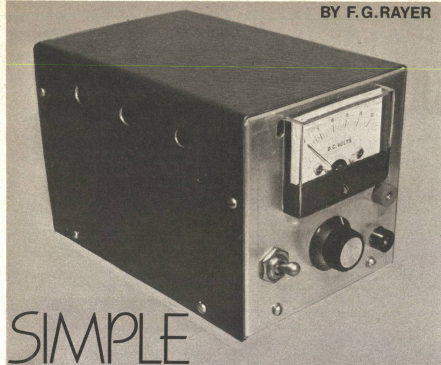
Simple Stabilised P.S.U.

No problems should be encountered when purchasing components for the Simple Stabilised P.S.U. The bolt together Universal Chassis appears to be only available from Home Radio.

Electroplating

Any readers who are contemplating building or attempting to undertake their own electroplating should pay heed to the warning contained in the Electroplating article. This applies particularly to the handling of chemicals.

BY F.G. RAYER



SIMPLE STABILISED P.S.U.

THERE is no doubt that a regulated and adjustable power supply unit is of immense utility to the constructor and experimenter of electronic projects. Some thought has been given to easing constructional work to make this project suitable for the beginner. Regulation is so good that if wished the cost can be reduced by omitting the meter—but more about this later. Output voltage is 1.2V to 20V at currents up to 1 ampere, adequate for very many purposes.

CIRCUIT DESCRIPTION

The mains transformer T1 has a 20-0-20V 1A secondary, with full-wave rectification by silicon diodes D1 and D2. The peak voltage across the reservoir capacitor C1 is about 28V, and this is the input to the LM317K regulator.

The LM317K has internal stabilising, feedback, regulating and current passing devices. The output voltage is a function of VR1 value between 0V and ADJUST and is given by:

$$\text{Output voltage} = 1.2 (1 + \text{VR1}/R1)$$

The LM317K can handle 1.5 amps but T1 rating limits the p.s.u. output to 1 amp. C2 and C3 effectively suppress transients, or instantaneous

mains voltage spikes which would otherwise reach the output.

To use the unit, it is only necessary to switch on by S1, set VR1 so that the voltmeter ME1 shows the wanted voltage, and plug in the apparatus to be operated, not forgetting to observe the correct polarity.

If the p.s.u. output leads are shorted, the end of R1 normally at positive potential becomes negative, and thus also the ADJUST input of the i.c. This protects the circuit, though naturally one would not leave the p.s.u. output shorted in this way.

NO METER

Changes in input voltage to the LM317K, or to output load current (within the normal limits) results in no visible change to the reading shown by the panel meter ME1. It is of course useful to have this meter to show the voltage at all times.

It can, however, be eliminated by fitting a pointer knob to VR1, with a scale glued to the panel behind this control. Connect a general purpose test meter set to its 0-20V or similar d.c. range, to the p.s.u. output sockets. The scale for VR1 can then be calibrated at 1.5, 2, 2.5, 5V and so on.

Subsequently you simply set VR1 to the wanted voltage before connecting any item of equipment to be run from the unit.

CONSTRUCTION starts here

CASE

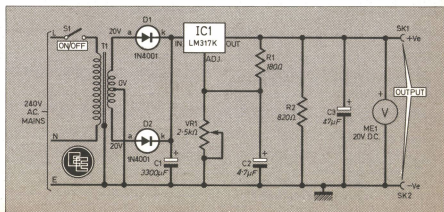
The case is built up from Universal Chassis members and is based upon 101×101mm flanged members for back and front, with a 152×101mm flanged member for the bottom, see Fig. 2. The top/side section is made from a piece of thin sheet metal or perforated metal 152×304mm, bent into a 101×101×152mm open box.

BACK PANEL

Prepare the back panel by drilling the four holes for mounting the LM317K. You must use a TO-3 power transistor type insulation set (mica washer and two plastic bushes).

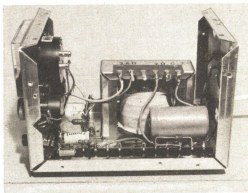
The mica can be used as a template to mark out the drilling positions for the required holes. Take care not to distort the back, and remove any

Fig. 1. The complete circuit diagram of the Simple Stabilised P.S.U.



SIMPLE STABILISED P.S.U.

COMPONENTS
approximate
cost **£18** excluding
case



Interior view of the finished prototype showing how the case is constructed from Universal Chassis parts.

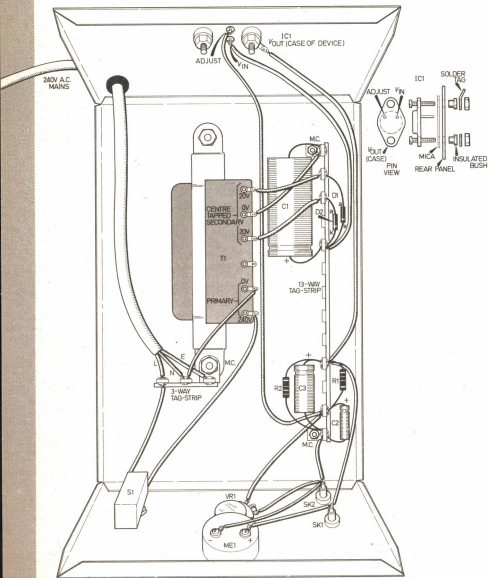


Fig. 2. Recommended layout of the components on the Universal Chassis with full interwiring details. Also shown top right are the mounting details for IC1 and its insulation set.

COMPONENTS

Resistors

- R1 180Ω ½W carbon ±5%
R2 820Ω 1W carbon ±5%

Capacitors

- C1 3300μF 30V elect.
C2 4.7μF 30V elect.
C3 47μF 30V elect.

See
**Shop
Talk**
page 30

Semiconductors

- IC1 LM317K adjustable volt-
age regulator i.c.
D1, D2 1N4001 1A 50V silicon
rectifier (2 off)

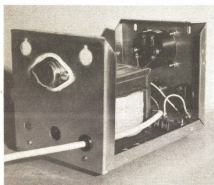
Miscellaneous

- VR1 2.5kΩ carbon or wire-
wound linear potenti-
ometer
S1 s.p. on/off toggle mains
ME1 20V or 25V d.c. panel
meter
SK1, SK2 4mm insulated sockets
(1 red, 1 black)
T1 mains primary/
20.0-20V 1A secondary
Standard tagstrip, 13-way and
3-way; Universal Chassis mem-
bers: 101 × 101mm flanged
members (2 off), 152 × 101mm
flanged member; sheet alumi-
nium or perforated metal size
152 × 304mm (case lid); insulation
set (mica washer and 2 insulating
bushes) for IC1; rubber grommet
for mains cable; suitable length
of 3-core mains cable; rubber feet
(4 off); fixing hardware for
transformer, IC1, case and tag-
strips; 1A insulated connecting
wire.

burrs from around the holes. Fit the mica washer between i.c. and back, with the insulated bushes in the holes in the latter, and fit a solder tag for the output connection. One of the thermal greases can be smeared on the meeting surfaces before fitting the i.c. to ensure good thermal contact. Check that case and pins are all isolated from the metal back panel.

FRONT PANEL

Drill fixing holes for S1, VR1, and the two output sockets, as shown. An



Shows the back panel with the i.c. mounted and ventilation holes.

opening for the meter can be made with an adjustable tank cutter, or with one of the screw-up type punches, or by drilling a ring of small holes closely together, so that a piece can be removed and the hole completed with half-round file.

VENTILATION

Several 9mm or similar holes should be punched or drilled in the bottom panel (which is raised by the feet) and also low down and high up on the back panel. If the cover is sheet metal, a row of holes can also be punched in each side of this.

BOTTOM PANEL

Drill fixing holes for the transformer and long tag strip. When front, back and bottom are assembled, secure four rubber feet with bolts and nuts, using the holes already present.

WIRING

With all parts fitted as in Fig. 2, wiring should now be carried out as shown. In the prototype blue was used for i.c. INPUT, green for ADJUST, and

red for OUTPUT and positive, for ease of identification.

Note how Live, Neutral and Earth of the mains cord are anchored. Fit a 3-pin mains plug correctly, with 2A or 3A fuse. Those points marked MC are firmly bolted to the metal chassis or box.

TESTING

You should measure nearly 29V across C1, but this will fall as current is drawn, though this does not influence the output voltage.

It is essential D1 and D2, and electrolytic capacitors, are wired with correct polarity. Check these before switching on.

Output should be absolutely stable, free of hum, and remain unchanged despite any changes in current drawn with in the p.s.u. rating.

Check the short-circuit protection network by placing a heavy gauge wire link across the output sockets for a short time. ME1 reading should drop to 0V, but return to previous level when link is removed.

Finally fix the cover in place with self-tapping screws which run into the flanges of back, bottom and front panels. □



I am greatly cheered by the large number of youngsters who take up electronics as a hobby, and undoubtedly many will want to adopt it as a career. Although these are hard pressed times, I think they have made a good choice, because there are openings at all levels with the really brilliant ones finishing up as designers.

At a slightly less elevated echelon, there are vacancies for electronic engineers on board ships. On a modern tanker or container vessel, the electronic engineering officer is almost as important as the captain.

In the next five years every garage worth its name will need an electronics expert. Those of you who saw "Tomorrow's World" recently probably were intrigued by the new cars coming on the market shortly, where the computer works out the exact speed at which the gear should be changed, and then proceeds to do it. Needless to say I know instinctively what would happen if I owned one. Going downhill it

would decide to change into bottom and the engine would race away sounding like an angry hornet, and going uphill it would change into top and promptly stall.

Mind you it is hard to think of anything today from washing machines to cookers that doesn't rely heavily on electronics, so in the service industries there must always be a demand for recruits, even though the time may come when they invent machines that service themselves. I don't object to any of this, provided that complication is not introduced without noticeable advantage.

Safety in Simplicity

James Watt had the problem of converting a reciprocating motion into a rotary one and he solved it very neatly by inventing the crank. One of his workmen pinched the idea and patented it, preventing Watt from using it. Watt then invented a dozen different ways of obtaining the same

result, but none so simple or effective as his original. The simpler a thing is the less likelihood of failure. As the late E. F. Schumacher said, "Any third rate engineer can make a complicated apparatus more complicated but it takes a touch of genius to find one's way back to basic principles. The more complex a thing is, the more it tends to break down and you can't repair it yourself."

If you take a simple thing like a spade, it can't go wrong! Make it mechanical and up go the chances of failure. Put an engine on it, the failure rate increases, and finally put an electronic control on it and it's a wonder if it ever works at all! And yet having said all that, take a piece of apparatus as complicated as a colour television set and they work for years without any trouble. Come to think, the handle of my spade broke in half this morning!

I suppose one day a mains plug and socket that is standard all over the world will be in general use and what a boon that will be to travellers. I expect many of you use electric razors and if you go abroad you are confronted with continental sockets which will only accept a continental plug. It is no good switching to a safety razor temporarily, because the electric shaver's beard is too soft.

I get round this problem by taking my clockwork razor with me when travelling. (Looks of incredulity on the faces of my readers!) No really, the one used by the man in the moon. (Ah! now we know old Young is pulling our leg!) Let me explain, this type of razor was used by the astronauts to conserve their battery supply. It has a small rotary head rather like a Philips, and with three complete winds I can get a perfect shave.



By BARRY FOX

Break Up

It has been fascinating to watch the British Post Office react over the last year or so to the reality of commercial competition. The PO's original attitude clearly reflected its position of total security, with a monopoly on everything connected with and to the British telephone system. Arrogant would not be too strong a word to use.

Now, progressive break up of the PO's power and demonopolisation by the Telecommunications Bill has brought a corresponding change of face by the Post Office. There's even been a change of name, to British Telecom.

Time Delay

British subscribers don't need reminding how bad it used to be just a couple of years ago. Long delays in installing new lines, a pathetically small choice of ancient technology dial phones and the compulsion to rent everything at high prices from either the Post Office or Post Office-approved suppliers. The Area offices, responsible for "selling" extra telephones knew little or nothing about what was available, and appeared to care even less.

Long distance phone calls were all too often hampered by the dreaded "all lines are engaged, please try later" and anyone trying to route a Trans-Atlantic call through a British operator had to wait an inordinate length of time. Worse still you had to join the same long queue for an operator even if you only wanted foreign directory help. And long distance multi-digit calls that failed had to be laboriously re-dialed because the Post Office didn't offer push button 'phones with the last number recall facility, whereby an entire string of digits can be recalled by the push of a single button.

Liberation

But meanwhile, in America, liberalisation of the similar monopoly held by the Bell Telephone Company filled the shops with exciting telephone equipment. Push button phones, answering machines, recorders; all could be bought outright for private installation.

Inevitably some of this equipment started to reach Britain, either as private imports in the suitcases of those who had taken their holidays abroad, or as bulk imports from Far Eastern manufacturers. Magazines and newspapers started to publish articles about what British subscribers were missing.

Dissatisfaction

Dissatisfaction grew and the Post Office added fuel to the fire by condemning foreign equipment out of hand and threatening to disconnect the phone lines of any British subscriber who dared to install it. Some of this criticism was in fact wholly justified.

Equipment designed for foreign use is often unsuitable for Britain. The US telephone network is for instance "gainy". Most lines are amplified whereas in the UK lines are often passive because we have a tradition of using low-loss copper.

Phone-In

At the end of June the London radio station, LBC, held an hour-long *Phone-In* on "What kind of telephone service does the public want".

Calls poured in from listeners who wanted to know what kind of special phones and services are available, and what we are likely to see in the future. There was a clear groundswell of resentment and confusion over what British Telecom does and does not have to offer a subscriber. (Incidentally it's clear that everyone still calls The Post Office "the Post Office", the title British Telecom certainly hasn't yet stuck).

I was in the studio and did my best to answer the questions that came through from listeners. Why, you may well ask, should a journalist be speaking on behalf of the Post Office? The answer is quite simply that although the Post Office were asked, literally days in advance, to send

So a telephone that produces acceptable levels of sound in the US may well be unusable in some parts of Britain. Also the ringer circuits of foreign phones may not match the British network. You can install an imported telephone and then find that some incoming calls don't ring your bell.

In Britain, where two extension phones are connected to the same line, the sound and ringer circuits are connected in a hybrid series/parallel circuit. This ensures a standard impedance across the line and prevents the bell of one phone from jangling while calls are made on the other. Many foreign phones don't offer the option of series/parallel connection.

Guidance Needed

Most important of all, anyone buying an unauthorised telephone, and trying to install it themselves, can't seek guidance and help from the Post Office engineers to get it right. This has dangerous implications. Any amateur trying to install a mains-powered gadget, for instance a memory telephone or automatic answering machine, could end up putting mains voltage on the phone lines if they get the connections wrong or have bought a cheap unit without adequate isolation.

The idea of an amnesty, whereby owners of unauthorised 'phones could pay the Post Office to help then get it properly installed, was too good. But the Post Office has already encountered a case where someone bought a mains-powered cordless telephone, which uses the mains wiring as aerial, and connected it up incorrectly so that mains power burned out his entire home 'phone system.

Incidentally, (and it's a topic we'll return to in future months), do bear in mind that liberalisation of the phone system will not affect the question of cordless phones. They use a radio link between a base station and hand set and they will remain illegal because they contravene the Wireless Telegraphy Act. Anyone caught using one is liable for heavy fines and/or imprisonment.

someone along to the studio they thought it wasn't necessary.

This decision was doubtless not unconnected with the fact that the LBC programme went out late on a Saturday night, rather than during weekday working hours. If British Telecom, nee The Post Office, can't muster a spokesman for an hour long live radio phone-in programme on a Saturday night in London, then what price Sir George Jefferson's brave promise that "We must be market responsive when we are competing with others".

The sad irony is that several Post Office engineers, and ex-Post Office engineers, had sufficient loyalty to their employer to phone in and try to defend the Post Office against callers' attacks. But there were no calls from Post Office management. They should be thoroughly ashamed of themselves. Do you suppose they are?



SCHOOLS



Electronic Design Award COMPETITION

over
£1,000
IN PRIZES

Mullard Ltd—the largest electronic components Company in the UK—and EVERYDAY ELECTRONICS join forces to present this rewarding challenge to Secondary Schools.



DESIGN A PIECE OF ELECTRONIC EQUIPMENT HAVING A DIRECT PRACTICAL APPLICATION IN A SCHOOLS SCIENCE LABORATORY

This competition is open to any United Kingdom Secondary School, State or Independent. Pupils of either sex in the age group 11-18 are eligible to participate in a team representing their school.

The competition will be conducted in two stages.

STAGE 1

Submission of Papers describing the proposed project with full circuit details.

Papers will be judged for novelty, ingenuity and viability. Particular attention will be given to originality and good circuit design technique.

Schools whose designs are adjudged to be the most promising will be asked to produce a working model of their designs.

STAGE 2

Models will be examined and prize winners selected on the basis of mechanical design, neatness of wiring and general assembly, plus operational performance.

All models will be exhibited at Mullard House, London, where the official presentation of prizes will be made.

FIRST PRIZE	£150	} plus a selection of components valued at £100
SECOND PRIZE	£100	
THIRD PRIZE	£50	
NINE RUNNERS UP	a selection of components valued at £50	

Science teachers of Secondary Schools are invited to apply for a Registration Form which contains full details of this competition.

Write to: Schools Competition
Room 2130
Kings Reach Tower
Stamford Street
London
SE1 9LS

Secondary School Pupils—make sure your school accepts this challenge and enters this inaugural contest. So bring this announcement to the attention of your science teacher or the head of your school.

Closing date for Registration: December 31 1981

Closing date for submission of Papers: February 16 1982



SCHOOLS ELECTRONIC DESIGN AWARD COMPETITION (SEDAC)
SPONSORED BY MULLARD LTD AND EVERYDAY ELECTRONICS



INTRODUCTION TO LOGIC

PART 8 BY J. CROWTHER

LOGIC MODULES (continued)

Example

To derive the Boolean expression and switching circuit for the module shown in Fig. 9.1.

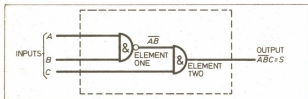


Fig. 9.1. Logic module to be translated to a switch arrangement.

The output from the NAND gate is of the form $\overline{AB}$, and this is fed to the input of an AND gate, with C to the other input. As the output of an AND gate is the product of the inputs:

$$\overline{AB}C = S$$

In order to convert this equation into one representing switching arrangements, we must apply Demorgan's Theorem, and get the "bars" over a single letter to represent normally closed switches.

$$\overline{AB}C = (\overline{A} + \overline{B})C = S$$

The equation $(\overline{A} + \overline{B})C = S$, represents the switch arrangement in Fig. 9.2.

Truth Table

The truth table for the module in Fig. 9.1 is shown below:

Input to element 1		Input to element 2		Output
A	B	C	$\overline{AB}$	$\overline{AB}C = S$
0	0	0	1	0
0	0	1	1	1
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	0	0
1	1	1	0	0

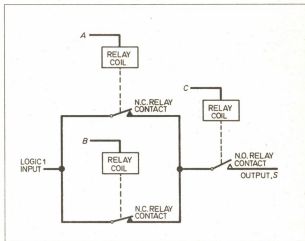


Fig. 9.2. Switch version of the module in Fig. 9.1.

FINDING GATES FROM EQUATIONS AND SWITCH ARRANGEMENTS

Example

Design a Logic Module to represent the switch arrangement in Fig. 9.3.

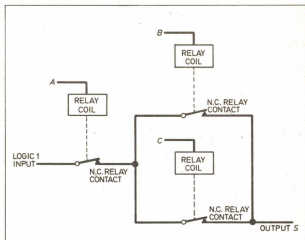


Fig. 9.3. Switch arrangement to be converted to a logic gate module.

Equation

$$A(B + C) = S$$

Since this equation is A, times (B + C), and the output from an AND gate is the product of the two inputs, the last gate must be an AND gate fed with A and (B + C), as shown in Fig. 9.4.

To get (B + C), we must have an OR gate fed with B, and C, so the final module is as seen in Fig. 9.5.

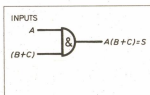


Fig. 9.4. First stage of conversion for Fig. 9.3.

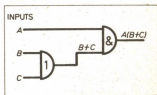


Fig. 9.5. Logic module for Fig. 9.3.

Example

Design a Logic Module to represent the switch arrangement in Fig. 9.6.

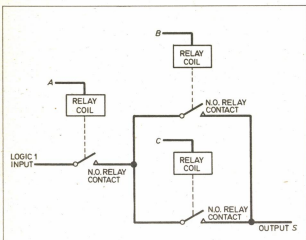


Fig. 9.6. Switch arrangement to be translated to a logic gate module.

Equation

$$A(\bar{B} + C) = S$$

Apply Demorgan's Theorem to convert the above equation into an expression representing gates, that is, join the "bars" to form a complete "bar" as shown:

$$\bar{A}(\bar{B} + C) = \bar{A}(\bar{B}C) = A + \bar{B}C = S$$

$A + \bar{B}C$ is the equation for a NOR gate fed with A , and BC , as shown in Fig. 9.7.

To obtain BC , we require an AND gate fed with B , and C , so the final module would be as seen in Fig. 9.8.

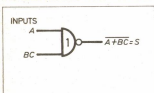


Fig. 9.7. First stage of translation for Fig. 9.6.

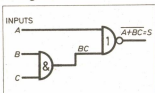


Fig. 9.8. Logic module for Fig. 9.6.

BOOLEAN IDENTITIES

In algebra and trigonometry, identities are used to simplify equations.

For example, in trigonometry $\sin^2 \theta + \cos^2 \theta = 1$.

The same applies to Boolean Algebra where identities are used to simplify equations to see if it is possible to reduce the number of switches required.

Boolean Identities

- (1) $AA = A$ also $\bar{A}\bar{A} = \bar{A}$
- (2) $A\bar{A} = 0$
- (3) $A1 = A$ also $\bar{A}1 = \bar{A}$
- (4) $A0 = 0$ also $\bar{A}0 = 0$
- (5) $A + A = A$ also $\bar{A} + \bar{A} = \bar{A}$
- (6) $A + 1 = 1$ also $\bar{A} + 1 = 1$
- (7) $A + 0 = A$ also $\bar{A} + 0 = \bar{A}$
- (8) $A + \bar{A} = 1$
- (9) $A + \bar{A}B = A + B$
 $\bar{A} + A\bar{B} = \bar{A} + \bar{B}$
 $A + \bar{A}B = A + B$
 $\bar{A} + A\bar{B} = \bar{A} + \bar{B}$

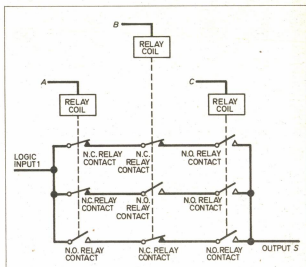


Fig. 9.9. Switching arrangement to be investigated by Boolean rules and identities.

example

$$ABC + \bar{A}BC + A\bar{B}C = S$$

This equation represents the circuit in Fig. 9.9, containing nine switch contacts.

Use the Boolean Rules and Identities, to simplify this equation and reduce the number of switches.

First of all, simplify the equation.

C is common to all terms, and can be put outside the bracket (see Rule 3 in Part 5):

$$C(\bar{A}B + AB + A\bar{B}) = S$$

A is common to the first two terms in the bracket, and can be brought outside using the same rule:

$$C[\bar{A}(\bar{B} + B) + AB] = S$$

$$\text{But } (\bar{B} + B) = 1 \text{ (Identity 8)}$$

$$\therefore C(\bar{A}1 + AB) = S$$

$$\text{But } \bar{A}1 = \bar{A} \text{ (Identity 3)}$$

$$\therefore C(\bar{A} + AB) = S$$

$$\text{But } (\bar{A} + AB) = \bar{A} + B \text{ (Identity 9)}$$

$$\therefore C(\bar{A} + B) = S$$

This last equation represents the switch circuit in Fig. 9.10.

It can be seen that the original circuit has been reduced from nine to three switch contacts to give the same result.

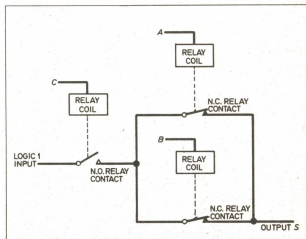
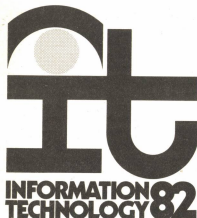


Fig. 9.10. Simplification of Fig. 9.9 after applying Boolean rules and identities.

TO BE CONTINUED

Everyday News



AN EXCITING ERA

A nation-wide campaign has been launched to make everyone aware of the information revolution and 1982 has been designated "Information Technology Year" by the Government.

A full programme has been planned for 1982 to help improve understanding amongst the general public, as well as in business and public administration. Leading figures from the fields of health, education, the arts, leisure, industry and commerce, the media, finance, Government and the Information Technology industry itself, are promoting IT in their own particular sphere.

Speaking at the launch of IT 82, Kenneth Baker MP Minister for Information Technology said "we are entering an exciting era, we are seeing the home of the future, the office of the future and the factory of the future emerge from the realms of science fiction and become reality. This is happening through the application of microelectronics to control of machines, to computing, to communications and to entertainment."

University Chips

University research departments throughout the UK are now able to design their own silicon microcircuits using the Rascal silicon gate CMOS uncommitted logic array (ULA) system.

The scheme, under the auspices of the Science and Engineering Research Council (SERC), is being coordinated by the Department of Electrical Engineering at Edinburgh University which has a £1 million silicon fabrication facility.

Contracts worth more than £700,000 have been placed with Sony Broadcast for Electronic News Gathering (ENG) equipment to be used in both East and West Germany.

Distance Links

Despite world recession international telecommunication links are scheduled for major expansion. In ocean cables a new 8,000 mile route will link Australia, New Zealand, Fiji, Hawaii and Canada.

Called ANZCAN, it comes into service in 1984, will carry twenty times the traffic of the existing COMPAC system and will cost £200 million.

As well as a new Europe-America cable planned for service in 1983 an additional link is now planned for 1988. The latter is expected to be engineered with optical fibres.

Aids for Disabled

Among the special equipment for the disabled demonstrated recently by British Telecom were a talking switchboard for blind telephone operators, and communications terminals for deaf people with moving strip visual display.

One of Britain's leading exhibitions organisers in the computer field, IPC Exhibitions, is to run a show covering the field of personal computers, home computing, small business systems and associated software.

The "Computer Fair," as the show will be named, will be held at Earls Court from April 23 to April 25, 1982.

Also demonstrated was a Prestel model for the blind or deaf, the former using a braille character generator in place of the TV screen, the latter using the moving strip visual display terminal and keyboard as used for deaf conversations.

Plessey Avionics and Communications have announced a £750,000 improvement programme for the restructuring of manufacturing facilities at their Vicarage Lane, Ilford, site.

This new and sophisticated area will be used to manufacture part of the Flammigan battlefield trunk communications system for the British Army.



BBC DESIGN SATELLITE TERMINAL

The BBC demonstrated its new mobile satellite link terminal to BBC Management and Senior Engineers at a recent Conference at the Institute of Electrical Engineers in London. The mobile satellite link terminal commissioned for Television Outside Broadcasts has just been completed by the BBC Engineering Research Department, and is undergoing pre-operational trials.

The first field trials included a "Morning Service" programme on BBC1, a contribution to the South West "Opt-Out" in the "Nationwide" programme and an edition of "Multicoloured Swap Shop". All these programmes originated in Guernsey in the Channel Islands and used the new satellite link.

Under normal conditions it is intended that the satellite link will be used over difficult transmission paths and not where conventional radio link circuits can be used.

The transmitter is very flexible and may operate on any of the available channels through the Orbital Test Satellite (OTS) or future European Communications Satellites.



Incredible as it sounds, French scientists have developed an ordinary standard sized credit card which houses a microprocessor and memory.

The user can use it in place of a cheque book, cash credit being inserted at the bank and purchases at shops deducted by placing the card in a counter-top terminal at which the user can also see how much cash balance remains.

Enhanced Teletext

In a programme of work supported by the UK Department of Industry, BBC Research Department has produced equipment to be used to study enhancement to the British teletext system.

One of the early uses of this equipment has been to produce a teletext decoder capable of displaying the normal pages as broadcast now, but with a much better quality of character generation than is found in the first generation mass-produced teletext decoder designs.

Fly-by-TV

The mass of instruments in airliner cockpits could soon largely be replaced by colour TV screens.

The idea is to call up on the screen only the data required for any particular phase of flight in respect of management and safety. A prototype system is now flying in a Royal Aircraft Establishment One-eleven aircraft.

Demonstration flights have been made in Europe and the United States in the expectation that such systems will be used in the next generation of airliners still at the drawing-board stage of design.

WORLD VIEW

A world-wide viewdata service is rapidly becoming a reality following a series of recent agreements announced by European and other countries to take the initial steps towards the interconnection of their national viewdata systems in 1982/83.

Following its success in West Germany, the gateway facility (which allows viewdata customers to get easy access to a wide range of existing, non-viewdata computers) is to be implemented in the Netherlands and Italy, as well as the UK.

In addition to allowing the connection of non-viewdata computer systems, gateway will result in the interconnection of national viewdata systems. This means, for example, that a Prestel user in the UK will be able to access the Bildschirmtext service in Germany and vice versa.

The Department of Transport is taking no chances in the event of a decline in petrol supply. It has commissioned the consultancy firm EASAMS to study all the requirements of a nationwide network of battery recharging points for electric vehicles. These could be at conventional garages, in parking lots or on the kerb side.

Custom Metalworking

The Card Frames Division of Vero Electronics has issued a new colour brochure detailing the comprehensive custom metalworking service offered by the company.

Using the latest machinery, the Card Frame Division is able to undertake DNC punching, forming, guillotining, engraving, component printing, anodising, painting and assembly work.

The Scottish Development Agency is to seek planning permission to set up a Science Park in Glasgow.

Hazard-proof Radar

The remarkable ability of lifeboats to capsize in mountainous seas and survive still has the handicap that the radar goes out of action after the rotating scanner has been immersed in sea water.

The problem has now been overcome with the development of a completely waterproof radar by Rascal-Decca in consultation with the Royal National Lifeboat Institution.

All radars in RNLI lifeboats are now being modified to waterproof standard, including those with open cockpits or wheelhouses.

In Agreement

The Scottish Development Agency have just revealed details of the financial assistance it has given to Inmap, the joint venture by Edinburgh and Herriot Watt Universities to promote the industrial application of microelectronics.

The Agency has reached an agreement with Inmap under which it will provide up to £300,000 over the next three years to encourage the introduction of microelectronics technology into small and medium-scale companies.

One of Scotland's best-known industrialists, Peter Carmichael, CBE, Joint Managing Director of Hewlett-Packard, has been appointed Director, Small Business and Electronics, of the Scottish Development Agency.

ANALYSIS

THE ELECTRONIC CHURCH

On first thought, religious institutions founded on ancient tradition would seem to have little need or use for electronics. Yet, if we accept that a principal activity of all religions is to propagate the Word it is clearly their duty that it should reach all peoples.

Facing such logic the normally ultra-conservative Roman Catholic Church was first in the field with high-powered world-wide broadcasts from Vatican Radio. The example was quickly followed by other denominations and sects and today there are scores of radio and TV stations round the world devoted entirely to religious worship and instruction and many organisations generating multi-lingual religious programmes.

At local level most religious buildings have electronic sound reinforcement and ancient cathedrals have inductive-loop-audio guided tours for pilgrims and tourists. The traditional harmonium in the chapel has long since been ousted by the electronic organ.

Loudspeakers in the belfry, tape-activated, are less expensive than bells and bell-ringers and, in Islam, the muezzin calling the faithful to prayer from the minaret is likewise tape-recorded. Along the Via Dolorosa in Jerusalem no self-respecting monk guiding pilgrims is now properly equipped without his shoulder-slung portable public address system.

The Mormon Church, whose faith embraces retroactive baptism, operates one of the largest computer systems in the world. Its giant data bank, protected from all hazards including nuclear war, records all traceable ancestors of today's three million living Mormons.

But while electronics is a powerful tool in promoting and aiding religious practices and, on a wider front, has enabled us to explore in detail physical quantities and qualities from the smallest atom to the immensities of outer space, no electronic instrumentation, however sensitive, has yet been able to measure or explain any spiritual, psychic or other paranormal phenomena. They remain eternal mysteries and perhaps better so.

Brian G. Peck.

ONE of man's greatest achievements in the last decade has been the sending of highly instrumented electronic robots to explore the more distant parts of the solar system. These spacecraft not only transmit signals back to earth from which high resolution photographs can be re-constituted but also send us a great deal of other data which will keep scientists busy for years to come.

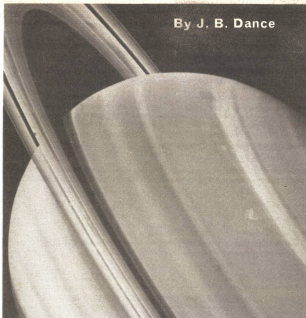
Sometime ago the Pioneer spacecraft sent us useful images of the enormous planet Jupiter and one of these craft returned images of Saturn, but these images were much inferior to those returned by the later Voyager craft. These craft were launched in August and September 1977. Voyager 1 reached Jupiter on March 5, 1979, Saturn on November 12, 1980 and is continuing to return highly valuable data as it moves out of the solar system without making any further planetary encounters.

The Voyager 2 spacecraft passed by Jupiter during July 1979 and reached the region of Saturn in late August/early September 1981. It is this Voyager 2 encounter with Saturn which is the subject of this article, but is interesting to note that the huge gravitational field of Saturn has been used to sling the spacecraft on towards an encounter with Uranus in January 1986 and hopefully with Neptune in August 1989.

Rings of Saturn

Saturn is one of the most beautiful objects in the heavens which can be seen by a telescope, but earth-based telescopes can capture only a little of the wealth of detail revealed by the Voyager spacecraft's imaging systems. Voyager 2 came closer to Saturn than Voyager 1 and carried better Vidicon camera tubes, so it provided rather better images.

Two rings are easily observed from the earth around Saturn separated by the well-known Cassini Division. Voyager 1 showed that there are hundreds of rings around the planet, whilst Voyager 2 (with its electronic memories specially programmed using the results of the Voyager 1 encounter) has shown that the number rings amounts to thousands or perhaps tens of thousands. Even the divisions between the rings themselves contain fairly faint rings, yet the thickness of the ring system is only about 2km!



By J. B. Dance

VOYAGER 2 ENCOUNTERS SATURN

It is believed that the rings consist essentially of small lumps of ice and rock individually orbiting the planet like tiny moons. The ring systems cast clear shadows on the surface of the planet itself.

Markings radiating outwards rather like the spokes of a wheel were detected in the B-ring by Voyager 1. One theory proposed that the spokes consist of dust particles levitated by the electric fields of the planet, but careful experiments with Voyager 2 did not find evidence to support this.

Further work with Voyager 2 examined the light of a star which had to pass through the rings before reaching the spacecraft. As Voyager 2 passed behind the rings, the effect of the rings on its radio transmissions enabled some estimate to be made of the size of the particles of the rings.

Lightning discharges in the vicinity of the planet which appeared to come from within the B-ring were detected. Measurements indicated that these lightning flashes were thousands of times more powerful than the lightning we experience on earth.

Scientists are very puzzled as to how the rings maintain their mechanical stability. It may be that moons of the planet help to keep the system stable, but there is still much to be discovered even though the spacecraft have sent us far more information than we had previously accumulated through centuries of viewing the planet.

Sphere of Gas

Saturn itself is believed to be mainly a huge sphere of gas kept together by gravitational attraction. Its markings are similar but less prominent than those on Jupiter. Very high wind speeds of more than 1,000 miles per hour have been found above Saturn.

Saturn consists mainly of hydrogen and helium gases and has a very low density. The temperature of its clouds is of the order of -190°C and it is not known whether there is any surface to the planet, as no light can penetrate the thick clouds.

Moons of Saturn

Apart from Saturn itself and its ring system, one of the main objectives of the Saturn encounters was an

investigation of the numerous moons which circle the planet.

Titan

Titan is not only the largest, but also the most interesting of these moons and was viewed by Voyager 1; unfortunately nothing could be seen through the dense cloud cover of the surface of the satellite.

Voyager 1 passed a hundred times closer to Titan than Voyager 2, since the trajectory of the latter was programmed to enable it to travel on to Uranus and Neptune and this would not have been possible if it had passed close to Titan. Indeed, Titan is of such importance that had Voyager 1 failed to return data on this moon, Voyager 2 would have been sent to encounter it and the future Uranus and Neptune encounters would have been lost.

Nevertheless, Voyager 2 returned valuable data on Titan and showed that some considerable changes had occurred since the first encounter. In particular, an instrument on board Voyager 2 looked at the polarised light scattered by particles in the atmosphere of Titan; this could not be done by Voyager 1, since its instruments had failed.

Titan is of particular interest, since it has a dense atmosphere (82 per cent nitrogen, 6 per cent methane and other gases) and molecules detected in this atmosphere are those which could give rise to life.

Other Moons

Apart from Titan, Voyager 2 came closer to the moons Enceladus, Tethys, Hyperion, Iapetus and Phoebe than the first mission. Enceladus has a surface which shows a great deal of past geological activity. Part of its surface is heavily cratered by bombardments a very long time ago, but other parts are relatively smooth, indicating that material has been ejected (possibly by volcanic activity) and has settled onto the original cratered surface. Strangely enough any volcanoes would be water volcanoes, since Enceladus is mainly ice!

The moon Tethys has a chasm groove several kilometers deep around nearly three-quarters of its circumference; it is 100km wide and some 2,000km in length. Voyager 2 also found a crater 400km in diameter with a central peak and some concentric rings. The

Our heading photo shows an image of Saturn and its rings returned by Voyager 2 from a distance of 13.9 million km from the planet. Note the shadow of the rings on Saturn and the banding marks on the surface.

surface of this moon is heavily cratered.

Hyperion is a strange moon, a disk-shaped elongated object of dimensions about $400 \times 250 \times 200$ km, which is battered and scarred with craters. Iapetus is another strange moon, since it has a dark side facing forward in its orbit around Saturn and a bright side facing backward.

The dark side is as black as asphalt and has given rise to much speculation as to its composition, since it has one of the darkest surfaces in the solar system.

The first images of the outermost satellite, Phoebe, were captured by Voyager 2. This orbits in the opposite direction to the other moons and may possibly be a captured asteroid rather than a normal Saturnian moon.

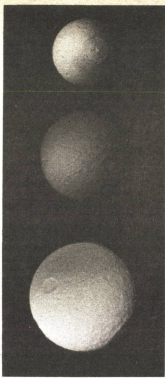
Radio Signals

All of this work (and many other projects) would not have been possible without the US Deep Space Network for receiving the extremely weak radio signals from the spacecraft. The Deep Space Network has stations in Goldstone, California, near Madrid, Spain and near Canberra, Australia. These stations have been deliberately spread out around the surface of the earth so that no spacecraft can be out of sight of all three of the stations at any time unless the craft is in the radio shadow of a huge object such as Saturn.

Spacecraft going towards the Sun can use solar panels to convert the energy of the Sun into the electric power they need. However, Voyager was designed to travel to the outermost parts of the solar system where the intensity of sunlight is very small, so it had to be provided with radioisotope thermoelectric generators to provide the power required by the radio transmitters and instruments.

Both Voyager craft receive signals from earth at a frequency in the S-band (over 2,000MHz). Signals sent from earth programme their on-board memories so that they make the desired observations at the right time and so that their small gas jets put them into the required trajectory and enable course correcting trajectory changes to be made. Voyager 2 had its main receiver fail, so it has operated on a duplicate receiver.

The spacecraft transmits at a maximum power of just over 28W in the S-band



A series of views of the moon Tethys taken at 4 hour intervals shows its 400km crater rotating towards the limb of this satellite. Note the central peak and the circles around the crater.

(about 2,300MHz), but can also transmit in the X-band at about 8,400MHz at a power level of up to about 21W.

The Voyager craft have a 3.7m diameter reflector dish which can be pointed towards the earth to provide good communications facilities with high data return rates at the great distance of Saturn. However, a low-gain antenna is also incorporated in the craft so that if the high-gain dish antenna happens to be facing away from the earth, a command signal can be sent to the low-gain antenna to cause the large dish to face the earth again.

The signals reaching the earth are so weak that the Deep Space Network stations have 64m diameter dish aerials to receive them together with smaller 34m and 26m diameter dish aerials for reception when conditions are not so critical. In addition, the smaller aerials can provide signals which can be fed to a computer together with the signals from the larger aerials to provide optimum reception.

Bad weather conditions (such as heavy rain or snow) at an earth receiving station can cause loss of the X-band signal. Some of the most important data was therefore recorded on the spacecraft's instruments and re-transmitted later to other earth

stations to provide a form of insurance against partial loss of the information which has been so costly to obtain.

Jammed Platform

When Voyager 2 was in the shadow of Saturn and out of radio communication with the earth stations, a moving platform which carries the cameras and certain other instruments became jammed in position. Although it could still be moved in the vertical direction, it could not be moved horizontally.

Engineers immediately set about investigating the problem, but any command signal they sent to the craft took about 1 hour 25 minutes to reach the craft and a similar time had to pass before the engineers could receive a signal back from the craft to ascertain whether the command had been effective. This long delay, due to the immense distance involved, made the investigations far more difficult.

The platform mechanism was finally freed after a few days and, although initially stiff, the performance of the movement has steadily improved. Thus the workers are anticipating there will be no problem at Uranus encounter.

As the sticking of the platform occurred shortly after the spacecraft had passed through the plane of the rings of Saturn, it was initially thought that the problem could have been due to particle bombardment of the mechanism with minute, very high velocity particles. Further investigation has shown that the problem was apparently caused by worn gear mechanisms, close clearances between gears and lubrication problems in the low-temperature, high vacuum conditions near Saturn.

Conclusions

The Voyager craft (and other planetary missions) are one of the marvels of modern electronics which has been able to answer questions over which man has pondered for centuries. Unfortunately even the USA is having to cut its expenditure on its space programme, but some projects will be going ahead during the early 1980's.

The writer is indebted to Don Bane, Jet Propulsion Laboratory, California for providing information and photographs used in this article.

EASIBINDERS

Quick, neat and easy!

It's so easy and tidy with the Easibind binder to file your copies away. Each binder is designed to hold 12 issues and is attractively bound and blocked with the EVERYDAY ELECTRONICS logo.

Price U.K. £4.30 including postage, packing and V.A.T. Overseas orders add 25p.

Please allow 3/4 weeks for fulfilment of order. Why not place your order now? Send the completed coupon below with remittance payable to:

IPC Magazines Ltd., Post Sales Dept.,
Lavington House, 25 Lavington Street,
London, SE1 0PF.

Order Form EVERYDAY ELECTRONICS

I enclose P.O./cheque value for

binders. Years required.....

BLOCK LETTERS PLEASE

Name

Address

Date

RADIO WORLD

By Pat Hawker, G3VA

FM or SSB

In the political rather than technological arguments about FM and AM for CB operation, there has been a tendency to knock unduly the performance that can be achieved with narrow-band FM. But it was a little surprising to find Dr. William Gosling, technical director of Plessey Electronic Systems Ltd, writing in "The Guardian" newspaper: "I am well-known as an opponent of the use of f.m.—for anything—on the grounds that it wastes valuable space in the radio bands. For CB radio I would have preferred the UK to adopt the more advanced s.s.b. system, now rapidly becoming dominant in the US".

Apart from the fact that use was being made of s.s.b. techniques as early as 1915 whereas we owe practical f.m. to Howard Armstrong's work in the 1930s, there remains many doubts about the effectiveness of s.s.b. for mobile operation; none about f.m.

Even Dr. Gosling's strong support for s.s.b. was less evident only a few years ago when he strongly advocated the alternative system of double-sideband a.m. with diminished carrier for private mobile radio. A system which indeed can be shown to have considerable advantages over s.s.b. for many applications but requires the use of fully synchronous detectors in the receivers.

Inconclusive trials

More recently the Home Office and Pye Telecommunications have carried out many tests on the use of s.s.b. systems (to which Dr. Gosling later turned) but these have proved far from conclusive. Indeed at distances of more than a very few miles, 25kHz channelling f.m. appears to have consistently outperformed s.s.b. (though it must be added that s.s.b. might permit 5kHz channelling).

For mobile operation to make full use of the narrow channels calls for a very high standard of sideband suppression and extremely good and complex automatic gain control in receivers. Also, there is an increasing problem of Doppler frequency shift when vehicles are travelling at speed when using the higher frequencies.

Broadcasters use wideband f.m. with around 200kHz channel spacing but can claim that for national coverage this is actually less extravagant in radio spectrum utilization than a.m. This is because the "capture effect" of f.m. permits the same frequency to be used many times over even in a relatively small area such as the UK whereas a.m. or s.s.b. require a much greater "protection ratio", that is to say an interfering signal has to be much stronger with wideband f.m. before it becomes objectionable.

So although for some purposes s.s.b. is definitely superior to FM or AM, it would not only result in unnecessarily complex

(and more costly) equipment for CB it is doubtful whether it would have any significant advantage.

CB licences

The actual conditions of the CB licence seem an odd mixture of a easy-going approach interspersed with tough technical conditions. For example there is not much that you cannot do, except to make grossly offensive or obscene remarks or speak in code. Likewise it is possible to use selective calling systems which are apparently not permitted by the amateur radio licence.

On the other hand, it is a condition of the licence that the aerial should not be more than 1.4 metre long with base loading, which is less efficient than a loading coil two-thirds of the way up or with top capacitance loading. On 27MHz unloaded quarter-wave ground planes, monopoles or half-wave dipoles are all well over 1.4 metres long and thus illegal.

One can see reasons for limiting the length of the aerial on a mobile unit, but one would have expected that for base stations at least the classic ground-plane aerial (originally devised in the 1930s by Dr George Brown of RCA for American police communications) would have been permitted. Perhaps it is all just to make it easier to spot "illegal" operators, though that may prove unfortunate for licensed amateurs with full-size aerials!

Brass pounders

For many years Morse operators have been called "brass pounders" although very few modern Morse keys are made of brass—more's the pity. Recently I spotted a collector offering (for about 260p) an 1899 brass key claimed to be in vintage condition.

This caught my eye since for many years I have used one of the classic double-current brass keys made by Griffin, London (No. 432 Mk. III 1914) with its massive brass terminals and gleaming "send/receive" switch. I have to admit that mine is not in "vintage" condition, cost me a princely half-a-crown in 1938, and is much more of a working tool than a collector's item.

In the interim period I have learned to use and tried out many other forms of

Morse key: the sideswiper, the semi-automatic "bug" key, the popular electronic keyer and the modern dual-paddle "squeeze" keyer. My conclusion is that there is no single "best" type of key but that individual operators gravitate towards the type that suits them best: in my case the large but elegant double-current brass key.

I also suspect that this once popular type of key has an advantage in that unlike most up-and-down manual keys the downward motion is not suddenly halted by the silvered electric contacts which are on springy metal but against a pliable washer. But also because, with the aid of metal polish and a rag, they become laboratory instruments with all the aesthetic appeal of gleaming brass—vintage Bentley's of an almost bygone era of telegraphy.

This feeling is clearly shared by others and I note that in New Zealand replica keys based on a once standard British Post Office key are now on the market.

Manual speed

According to the Guinness Book of World Records, Harry Turner, W9YZE is credited as holding the record for fast sending on a purely manual key, having clocked up 175 characters per minute (35 words per minute) in November 1942 at the US Army Signal Corps School at Camp Crowder, Missouri—and he still pounds brass on the amateur bands.

To reach 35 wpm is no mean achievement although I have come across operators capable of reaching about 30 wpm on good straight keys. The real beauty of such sending is not usually the speed but good letter formation and the absence of errors that tend to mar the "perfect" sending of electronic keyers.

Reliability

The strong emphasis put by consumers on "reliability" as the most desirable characteristic of any complex electronic equipment is increasingly recognized by industry in Europe and North America and has long been exploited by Japanese industry.

A recent special issue of the professional IEEE "Spectrum" journal is largely devoted to reliability and also sheds some light on the rising cost of repairs. It is pointed out that a good 19-inch colour television set in the USA retails for about \$400 while a typical service call to the home costs from \$35 to \$100 for labour and replacement parts.

If only one in a hundred receivers requires a service call during the warranty period, and taking an average of \$50 per call, the cost of unreliability to the manufacturer is 50-cents per set. But if one in ten sets requires servicing it amounts to \$5 per set.

Next month
**Everyday
ELECTRONICS**

FEBRUARY 1982 ISSUE
ON SALE
FRIDAY, JANUARY 15

February 1982

M.W.
SUPERHET RECEIVER

STEREO RECORD PLAYER
CAR OVERHEATING ALERT
CINE FRAME COUNTER & INTERVAL TIMER

**Part 2 of
Auto Garage Door
and all
the Regulars, of course!**



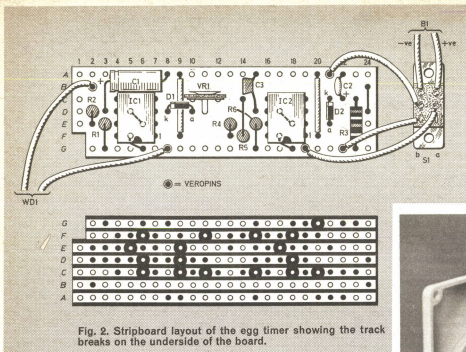


Fig. 2. Stripboard layout of the egg timer showing the track breaks on the underside of the board.

the aperture, two small holes can be drilled for the fixing screws.

Finally drill a 3mm hole in the centre of the case lid for the sound from the transducer.

CIRCUIT BOARD

First, cut the Veroboard to the size indicated in Fig. 2 noting the rebate required to fit round the corner pillar of the case. Then, using a hand-held 3mm drill or Vero track cutting tool, cut the copper strips in the positions shown.

Soldering should commence with the wire links indicated in Fig. 2. Note the two small diagonal links positioned under each of the i.c.s. Check the position of these links carefully; mistakes will be difficult to rectify once the i.c.s have been soldered into position.

Normal practice is to leave the installation of "active" components such as the i.c.s until last but in this instance there is some merit in reversing the procedure to assist the physical location of other components. Start, therefore, with IC2 taking care to ensure that it is correctly orientated by referring to Fig. 2. Continue by installing R5, 5 and 6, preset VR1, C1 and D2 (observing the polarity of the latter two components). Clip off surplus leads close to the soldered joint.

The value of R4 depends on the tolerance of the other timing components and may need to be changed to achieve the desired preset time period. At this stage temporarily fit a 120k Ω resistor.

Now wire the piezo-ceramic transducer, the slide switch and the battery clip taking great care in the case of

The sound transducer mounted on the lid and the close packing of the circuit board and battery.

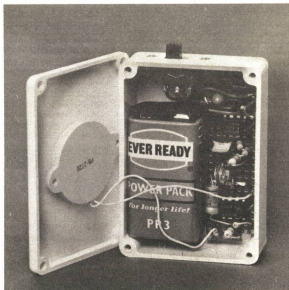
the last two items to observe correct orientation. Connect a PP3 battery and switch on whereby a continuous note should be emitted.

If all is well, disconnect the battery and proceed with the installation of IC1 and all remaining components except C2. Reconnect the battery when this time a modulated bleep should be produced.

The final step is to install the main timing capacitor, C2. The preferred choice here is a tantalum capacitor which is less likely than an electrolytic capacitor to deteriorate with age thereby affecting the timing cycle but a small electrolytic capacitor (10V working) can be physically accommodated, however, and will give acceptable results with probably some saving in cost.

ADJUSTMENT

The final, if somewhat tedious, operation is to adjust the preset resistor VR1 to give an accurate timing period, the duration of which depends on the constructor's personal preferences as to the consistency of their boiled eggs! The author enjoys a three-minute egg, so we shall describe the setting up procedure for such. Rotate the preset to its mid-point position, reconnect the battery and switch on, timing the period before the alarm sounds and repeat this process as



necessary, each time adjusting VR1 to obtain a duration of exactly three minutes.

If it transpires that this interval is not within the range of VR1 it will be necessary to increase R4 for longer intervals or reduce its value to shorten the period.

It may be, of course, that the constructor prefers his eggs cooked for four minutes or wishes to set up for some other timing function. In that event it would be desirable to vary R5 at the outset and a four minute timer would require about 1.5M Ω in this position.

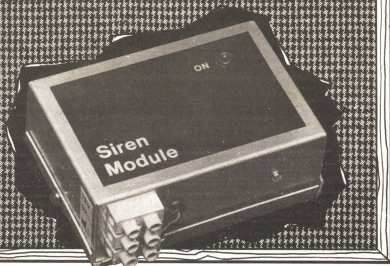
FINAL ASSEMBLY

When all adjustments have been completed, wire in R4 permanently and attach the transducer to the underside of the lid with a couple of dabs of adhesive, taking care to line up its centre hole with that drilled in the lid. Insert the slide switch in its case and screw the slide switch into position. No other fixing is necessary as the battery will hold the board neatly in place.

Screw the lid to the case, and finally, attach a label indicating the preset timing period of the unit. $\square$

SIREN MODULE

BY A. R. WINSTANLEY



THE device described in this article generates a US police-car type "whooping" tone and is suitable for many medium-power alarm applications. The tone is sounded over a 5 watt loudspeaker and in fact the level of output available is quite startling. The module can be used with burglar alarms, fire alarms or in fact in any unit requiring a distinctive audible alarm and which is capable of supplying 12 volts at about 500mA.

It is possible to incorporate a small modification which permits the module to imitate the familiar two-tone sequence of many British police cars.

THE 555 TIMER I.C.

The circuit employs two 555 timer i.c.s, both of which are operated in the astable mode. This is illustrated in Fig. 1.

An astable multivibrator possesses no stable state, and continues to offer a steady stream of pulses at its output without the need for triggering. In the case of a 555 astable, a constant square wave (Fig. 2) appears at the output terminal. The frequency, or number of pulses per second (measured in hertz), is dependent

upon the values of three external timing components, namely R_a , R_b and C . Fig. 2 illustrates how the frequency is controlled by these three components.

The other interesting features depicted in Fig. 1 are the "reset" and "control voltage" facilities. The reset pin, if grounded, will halt the output, that is the output will go low and remain like this until the reset signal is removed. It is customary to connect the reset pin to $+V_{cc}$ (the positive supply rail) if it is not required.

CONTROL VOLTAGE

The "control voltage" pin provides another means of adjusting the frequency of the output. Apart from altering the values of R_a , R_b and C , a control voltage may be applied to pin 5 to vary the output frequency independently of the "RC network".

By applying a voltage to pin 5, it is possible to modulate the frequency of the square wave output in sympathy with the amplitude of the control voltage. This method is employed in the Siren Module where the applied voltage has a sawtooth waveform.

If the control voltage terminal is unused, normally it is connected to

0V via a 0.01 μ F capacitor, although for a minimum component count it can be left entirely unconnected.

CIRCUIT DESCRIPTION

The circuit diagram of the Siren Module is shown in Fig. 3. It can be seen that two 555 astable circuits are employed, IC1 and IC2 with associated timing components. IC1 produces a square wave operating at a nominal frequency of about 500Hz; this forms the basic "tone" of the system.

IC2 produces another square wave of a much lower frequency, about 3Hz. Note however that a variable resistor VR1 is incorporated so this frequency is adjustable to a certain extent. VR1 was in fact eventually incorporated in the design to compensate for large tolerances which affect the value of C3.

The output of IC2 is coupled through R_4 and R_5 to the control voltage terminal of IC1. C_2 is a large-value electrolytic capacitor whose presence converts the square wave produced by IC2 into a sawtooth waveform.

The square wave from IC2 causes C_2 to constantly charge up and discharge, and so the smooth sawtooth waveform produced by this is used to modulate the output of IC1; the frequency of operation of IC1 is altered rhythmically to produce a "whooping" tone instead of a continuous 500Hz note.

As a basis for experimentation, readers may wish to note that by omitting C_2 , a "two-tone" effect will

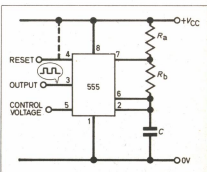


Fig. 1. Basic arrangement of a 555 timer i.c. to function as an astable multivibrator.

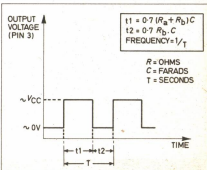


Fig. 2. Output waveform and frequency calculation for 555 astable.

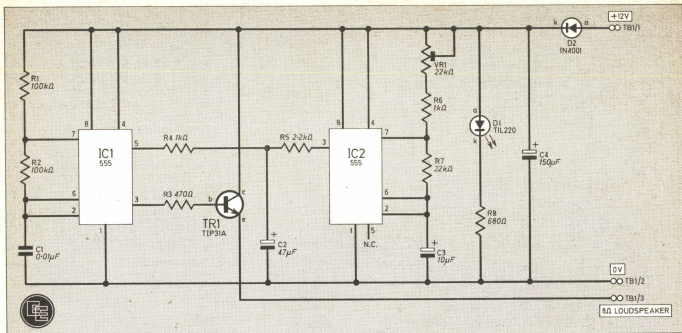


Fig. 3. The complete circuit diagram for the Siren Module.

COMPONENTS

Resistors

- R1 100kΩ
- R2 100kΩ
- R3 470Ω
- R4 1kΩ
- R5 2.2kΩ
- R6 1kΩ
- R7 22kΩ
- R8 680Ω

All ½ watt carbon ± 5%

Capacitors

- C1 0.01μF polyester (C280)
- C2 47μF 12V elec. radial leads
- C3 10μF 12V elec. radial leads
- C4 150μF 12V elec.

Semiconductors

- IC1, 2 555 timer i.c. 8-pin d.i.l.
- TR1 TIP31A npn silicon
- D1 TIL220 0.2 inch red l.e.d.
- D2 1N4001 1A silicon

Miscellaneous

- VR1 22kΩ sub-miniature horizontal preset
- TB1 3-way 2A screw terminal strip
- Stripboard: 0.1 inch matrix 18 strips × 37 holes; 8-pin d.i.l. sockets (2 off); clip/bush for D1; TO-220 insulating kit for TR1; rubber grommet; metal case size 100 × 70 × 40mm; Veropins (5 off); p.v.c. covered stranded wire; 6BA fixing hardware; 2mm diameter sleeving; 22 s.w.g. tinned copper wire; Loudspeaker and enclosure—see text.

Approx. cost
Guidance only

£4

excluding
speaker

See
**Shop
Talk**
page 30

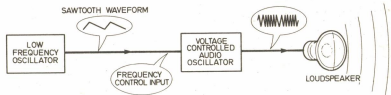
be produced. This is because a square wave is being used directly as a modulating signal for IC1, so that the 500Hz tone is suddenly increased and then decreased again, producing two separate notes.

The final "whooping" tone is available at pin 3 of IC1, but the maximum current that can be supplied is only 200mA. This is insufficient for the required 5 watts power output. TR1 functions as a current amplifier to realise 5 watts into an 8 ohm speaker.

An 8-ohm loudspeaker (minimum) should be used, with a minimum power rating of 5 watts r.m.s. An ex-music-centre loudspeaker mounted in an enclosure has been used with the

prototype with very great effect. Note however that the loudspeaker is connected to the Siren Module through a terminal block, but it will be possible to mount an unboxed Siren Module in the loudspeaker enclosure itself.

The circuit requires a 12V supply maximum at 500mA maximum, 300mA minimum. D2 protects the circuit from damage which could occur if the power supply happened to be accidentally reversed upon initial switching on. Finally, D1 is a light-emitting diode which glows when the power is on, and C4 serves to decouple the power supply and prevents unwanted interaction between the two oscillators.



HOW IT WORKS

A low frequency oscillator has its output "shaped" to provide a sawtooth waveform. The second audio frequency oscillator, without any signal fed to its control input produces a tone of about 500Hz. The effect of the sawtooth voltage is to cause this tone to vary in pitch about 500Hz, the shape of the sawtooth producing a "whooping" tone. This is heard in a loudspeaker via a current booster amplifier (not shown).

SIREN MODULE

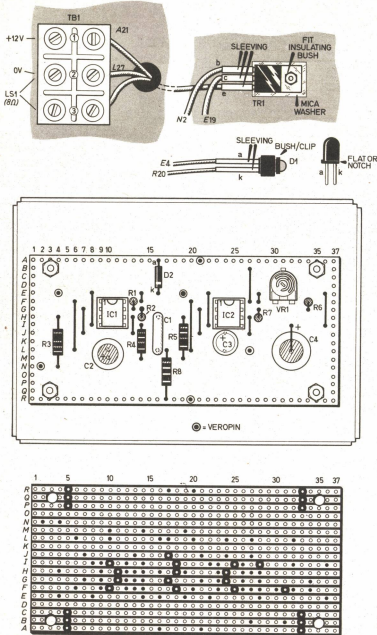
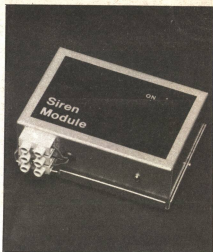


Fig. 4. Layout of the components on the stripboard and breaks to be made in the tracks on the underside. Veropins are used as anchorage points for wiring the remote components to the circuit board. Sockets are advised for both i.c.s.



The completed siren showing the mounting of the supply and loudspeaker connecting terminal block on the side of the case.

CONSTRUCTION starts here

CASE

The Siren Module can be built into a standard aluminium box measuring 100×70×40mm and the circuit itself—with the exception of TR1—can be constructed on 0.1-inch stripboard, 18 strips×37 holes.

Any other metal case can be used providing that it is of a size suitable for carrying the completed circuit board.

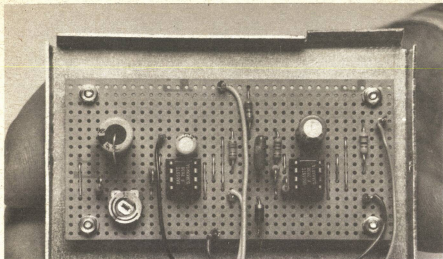
CIRCUIT BOARD

Fig. 4 illustrates the suggested stripboard layout. Having cut the stripboard to size, drill four 6BA clearance holes in each corner as shown to take the necessary mounting hardware. Take care when drilling to make sure that the circuit board is not fractured due to excess pressure.

Then all the breaks in the copper strips are made, using either a hand-held twist drill or the proper spot face cutter. The Veropins may then be inserted and soldered in the positions indicated.

At this stage it may be best to solder in the two 8-pin d.i.l. sockets which carry the i.c.s. These serve as a good reference when locating and soldering the 22 s.w.g. tinned copper link wires.

The recommended order of construction continues with the soldering in of the miniature resistors and the electrolytic capacitors.



The completed circuit board mounted in position on the base of the case. The cutaway in the lip to avoid obstructing the terminal block can be seen top right.

HEATSINK FOR TRANSISTOR

During normal operation, the temperature of TR1 will rise noticeably, and so the aluminium box is used as a heatsink to dissipate some of this heat, the reason for specifying a metal box to house this project.

TR1 is mounted on one wall of the aluminium box with 6BA hardware, using a TO-220 mica washer and insulating bush to isolate the transistor tab (which is internally connected to the collector) from the box. A smear of silicon grease or similar heatsink compound on both sides of the mica washer will assist in heat transfer from the transistor to the heatsink.

Note that it will be easier to solder a flying lead to each of the terminals before fixing in place.

TERMINAL BLOCK

Mounted externally on the case is a 3-way screw terminal block which carries the connections for the positive supply rail and also one terminal of the loudspeaker; the third screw terminal forms a combined loudspeaker terminal both the 0V and remaining loudspeaker terminal. Bear in mind that the lip of the lid overlaps about 6mm when positioning the terminal block on the outside of the case.

A small hole must be drilled next to the terminal block and this hole should be fitted with a small grommet. Flying leads are then taken from the appropriate Veropins on the circuit board, through the hole to the terminal block as shown.

The light-emitting diode can be mounted on the front of the box using and I.e.d. bush-clip. The I.e.d. must be positioned such that its leadouts will not interfere with the circuit board

so that you can easily identify the leadouts.

Standard multicore hook-up wire can be used throughout as flying leads, with 2mm diameter p.v.c. sleeving pushed over the leads of the I.e.d. and TR1 to ensure that short-circuiting will not occur.

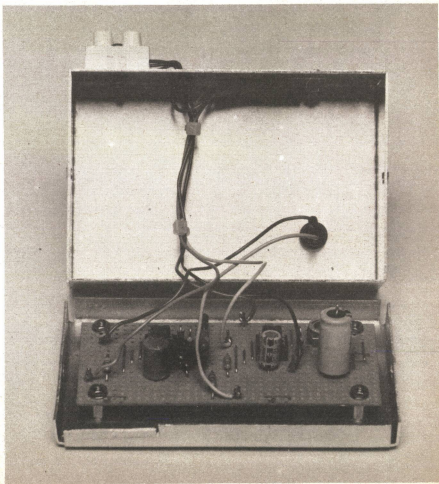
TESTING AND SETTING UP

Once construction is complete, check out the finished unit carefully. In particular inspect the circuit board closely, and fit the I.C.s correctly into their sockets if you have not already done so. Set VR1 to middle position.

Connect a suitable loudspeaker to the 0v and I.S terminals of the module, and then apply 12V (500mA maximum) to the +12v and 0v terminals.

Switch the power on: the I.e.d. should illuminate and the Siren Module should drive the speaker, but the "whooping" tones may not be perfectly formed. By adjusting VR1 it should be possible to produce the desired effect. II

The "lid" or base of the siren removed showing clearly how the circuit board is mounted on spacers. The I.e.d. is seen on the right of the case with insulating sleeving over the pins. Take care that the I.e.d. does not foul on the circuit board.



ELECTROPLATING

OF NON-CONDUCTIVE OBJECTS

by R. M. Henderson

THERE ARE many objects whose appearance can be enhanced by electroplating. The drawback is that many of them are non-conductors; for example, leaves and leaf skeletons and plastic models.

The methods involved are quite easy to follow and require no specialist equipment.

FIRST STEPS

The first step is to obtain a bottle of "Aquadag". This is a colloidal suspension of graphite and may be bought at a good chemist or photographic dealer. If any difficulty arises then you may have to resort to a scientific equipment dealer (look in Yellow Pages).

The object to be plated must be perfectly clean, dry and free from grease. A good wash in detergent followed by a rinse in distilled water will ensure this. Handle with tongs or tweezers at this stage as fingers are naturally greasy.

The object is then left to dry and then painted all over with Aquadag using a soft brush to ensure that all the detail of the object shows through the coating. A second coat is applied when the first is dry.

THE CELL

An electroplating cell must now be constructed. This consists basically of two electrodes, one formed by the object to be plated and the other formed from the material that is going to be deposited onto our object, and an electrolyte, or solution in which the two electrodes are immersed. The whole system is, of course, contained in a tank or vessel of some sort.

The ideal vessel would be a rectangular glass tank. However, any large container such as a plastic bucket or bowl would do just as well.

For obvious reasons, a metal tank would not be suitable as it would bypass the action of the cell.

An electrical connection is made to a part of the object which will not show or may be cut off when finished and this connection is taken to the negative side of the battery or power supply. This should be well smoothed and give at least 6V d.c. The object becomes the negative electrode or cathode.

A positive electrode or anode should also be constructed and this should consist of a thick rod or

preferably plate of the metal to be deposited onto the cathode. Needless to say this is connected to the positive terminal of the battery.

The anode should, if at all possible, be of greater surface area than the cathode and if metal plate or foil is not available, rod or wire can be heated and beaten flat. Several interconnected pieces may be needed.

PLATING CURRENT

The best plating is done when the current is 10mA per square centimetre of cathode, although areas need not be exact. If you were plating plastic chessmen for example, you could regard them as cylinders and calculate the surface area from the usual formula; Area equals $2\pi rh + 2\pi r^2$, where h is the height and r the radius in centimetres.

The area of a leaf can be found by drawing round it on centimetre graph paper and counting complete centimetre squares then adding half the number of incomplete squares before doubling.

Ideally the cathode should revolve slowly all the time (the method is outside the scope of this article), but a turn through ninety degrees each quarter of the total plating time will do. In fact this can take up to 48 hours depending on "plate" thickness.

Do not try to hurry the plating by increasing the current as this causes the result to be very granular and the plated metal does not adhere properly to the object.

The choice of electrolyte and operating temperature depend on the metal being plated and Table 1 summarises the best solutions and working temperatures.

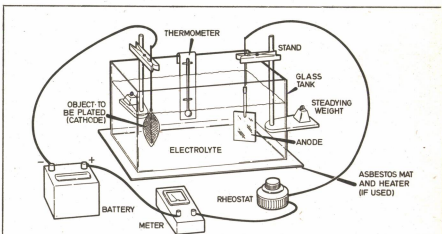


Fig. 1. A practical electroplating set-up.

Table 1: Electrolytes for different metals

Metal to be plated	Electrolyte details	Comments
Copper	12-5g copper sulphate crystals and 12 drops of battery acid in one litre of water.	Strong coat of copper at 38°C; softer coat which polishes easily at 50°C; adequate plating at room temperature.
Zinc	50ml of saturated zinc sulphate solution with an equal volume of water. Add 4 drops of battery acid and a teaspoon of Borax.	Temperature makes little difference.
Nickel	50g of nickel ammonium sulphate in one litre of water.	Temperature makes little difference.

Note that a saturated solution is made by warming water and dissolving as many crystals as possible. When allowed to cool to room temperature, crystals appear at the bottom of the vessel and the liquid above these crystals is the saturated solution.

FINISHING OFF

If a leaf or other organic object is plated, a small hole must be made through the plating in an inconspicuous place or the stem cut off revealing the interior. The leaf is then gently warmed at first and then more strongly until it carbonises leaving an empty shell of plated metal.

The melting points of copper, zinc and nickel are 1083, 420 and 1453 degrees Celsius respectively, so a little care is necessary here, especially with zinc. Any discolouration due to the heating can be removed with metal polish. If the leaf is not totally destroyed, gases from its decomposition may damage the plating.

This small hole can be sealed when the heating process is completed using Araldite mixed with filings of the appropriate metal and carefully ground level with carborundum paper.

SOME PRACTICALITIES

A suitable practical set-up for electroplating is shown in Fig. 1. The stands are made from half-inch dowel inserted and glued into pre-drilled

holes in a wooden base approximately 100x150mm in size. A clothes peg is then glued onto the rod in the position shown in the diagram. Two of these are required.

A weight placed on the base of the stand may be necessary to prevent it overbalancing.

The tank containing the solution (electrolyte) rests on an asbestos mat. If an electric heater is available so much the better. **However only use heaters that have been specifically designed for this sort of work (for example photographic tray heaters) as a mixture of water and electricity can be very dangerous. This rules out home-made contraptions.**

The electrical circuit consists of a battery, meter and variable resistor or rheostat. The rating of these particular items will depend on the job in hand but, bearing in mind that you require 10mA per square centimetre you should plan for about a maximum of 100 to 150 square centimetres. This means that your ammeter should be capable of measuring 1.5A and the battery should be capable of delivering a continuous current of

1.5A for an appreciable time. In practice this will mean using an accumulator such as a car battery.

The rheostat should again be adequately rated so you will probably need a wire-wound type rated at 20W for 12V working or 10W for 6V working.

The time taken to plate an object can vary and the surest way of working this out is by experience and a sharp eye. Although the time required depends largely on how thick the coating is going to be, you are going to need several hours to complete the process.

MAINS POWER

As an alternative to using a battery, you could try using a mains power supply. This has several advantages especially if you have access to a stabilised supply where all the control is built in. This would enable you to dispense with the rheostat and separate meter.

The main requirement is that the supply is well regulated and smoothed and once again able to supply the current demanded for the process. □

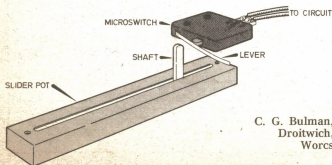


Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

SWITCHES FOR SLIDER POTS

It is possible to obtain rotary potentiometers with a switch incorporated which turns off at one end of the travel. However, slider pots never have this. Therefore I have thought up a simple method of adding a switch.

A lever operated microswitch is mounted at one end of the slider so that at the extreme end of its travel, the shaft presses against the lever and opens the normally closed contacts.



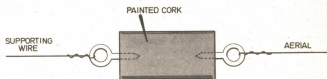
C. G. Bulman,
Droitwich,
Worcs

BALANCING AMPLIFIER CHANNELS

The balancing of the output of multiple channel audio amplifiers can be performed by connecting a speaker across the two non-common terminals (sometimes marked "output" or "+", in other words those not connected to earth or the chassis) of the channels to be balanced. With the same signal to both inputs of the amplifier channels (or the amp switched to mono) and the volume or gain turned up, the balance and/or tone controls are adjusted until there is as near to no volume as is possible. The amplifier is now balanced.

This method may be used for balancing low output a.f. amps or r.f. amps provided an a.c. voltmeter or oscilloscope is connected in place of the speaker.

C. M. Rogers,
Wootton-under-Edge, Glos



CHEAP AERIAL INSULATOR

Porcelain or glass aerial insulators can often be costly items to buy in the shops but there is a simple and cheap alternative (see diagram).

First of all take a cork and put a small screw eye in both ends. No holes need to be drilled because the cork is soft and they can just be screwed straight in.

The supporting wire is attached to one screw eye and the aerial to the other. Before it can be used it must be water-proofed with paint or varnish.

If a heavier duty or better quality insulator is required then the cork can be replaced by a piece of pine.

John Hickson,
Bexley, Kent

SQUARE one FOR BEGINNERS

TRANSISTORS come in a variety of shapes and sizes, the type of encapsulation often depending on the function it performs in a circuit. For example, a power transistor needs to be fairly substantial to dissipate unwanted heat whereas a high frequency device will require a metal can for screening.

Detailed here are the physical outlines and lead configurations, along with important electrical parameters.

TRANSISTOR PARAMETERS

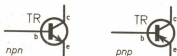
I_C (max): maximum collector current.

V_{CE} (max): maximum voltage allowed across the emitter and collector terminals.

h_{FE} : d.c. current gain (large signal gain).

P_{TOT} : maximum permissible power dissipation in the device.

f_T : the frequency at which the current gain (h_{FE}) drops to unity.



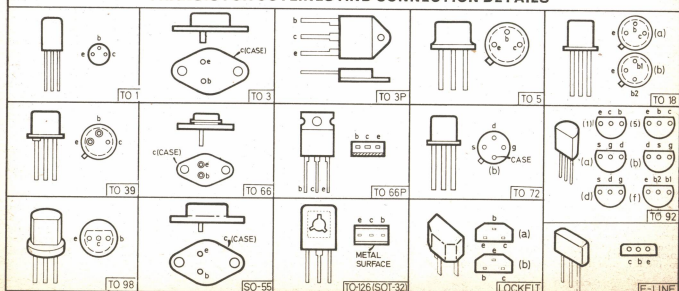
The circuit symbols representing the two types of bipolar transistor.

BIPOLAR TRANSISTORS

Device	Case	Material	V_{CE} (max) (V)	I_C (max) (mA)	h_{FE} (min/max)	P_{TOT} (mW)	f_T (MHz)
AC127	TO-1	nG	12	500	50	340	2.5
AC128	TO-1	pG	16	1A	60/175	700	1.5
AD142	TO-3	nG	50	10A	30/-	30W	0.5
AD149	TO-3	pG	50	3.5A	30/100	22W	0.5
AD161	SO-55	ng	20	3A	80/320	4W	3
AD162	SO-55	pG	20	3A	80/320	4W	1.5
BC107	TO-18(a)	nS	45	100	110/450	360	250
BC108	TO-18(a)	nS	20	100	110/800	360	250
BC109	TO-18(a)	nS	20	100	200/800	360	250
BC147	LOCKFIT	nS	45	100	110/450	350	300
BC148	LOCKFIT	nS	20	100	110/800	350	300
BC149	LOCKFIT	nS	20	100	200/800	350	300
BC182L	TO-92(1)	nS	50	200	100/480	300	150
BC184L	TO-92(1)	nS	30	200	250/-	300	150
BC212L	TO-92(1)	pS	50	200	60/300	300	200
BC214L	TO-92(1)	pS	30	200	140/600	300	200
BC477	TO-18(a)	pS	80	150	110/950	360	150
BC478	TO-18(a)	pS	40	150	110/800	260	150
BC479	TO-18(a)	pS	40	150	110/800	360	150
BD131	TO-126	nS	45	3A	20/-	15W	60
BD132	TO-126	pS	45	3A	20/-	15W	60
BD237	TO-126	nS	100	2A	25/-	25W	3
BD238	TO-126	pS	100	2A	25/-	25W	3
BFY50	TO-5	nS	35	1A	30 typ.	800	60
BFY51	TO-5	nS	30	1A	40 typ.	800	50
BFY52	TO-5	nS	30	1A	60 typ.	800	50
TIP31A	TO-66P	nS	60	3A	10/60	40W	8
TIP32A	TO-66P	pS	60	3A	10/40	40W	8
TIP41A	TO-66P	nS	60	6A	15/-	65W	3
TIP42A	TO-66P	pS	60	6A	15/-	65W	3
TIP2955	TO-3P	pS	60	15A	5/30	90W	8
TIP 3055	TO-3P	nS	60	15A	5/30	90W	8
ZTX300	E-LINE	nS	25	500	50/500	300	150
ZTX500	E-LINE	pS	25	500	50/300	300	150
2N697	TO-5	nS	40	1A	40/120	600	50
2N2926G	TO-98	nS	25	100	235	360	100
2N3053	TO-39	nS	40	1A	50/250	800	100
2N3054	TO-66	nS	55	4A	25/100	25W	1
2N3055	TO-3	nS	60	15A	20/70	115W	1
2N3702	TO-92(1)	pS	25	200	60/-	360	100
2N3704	TO-92(1)	nS	30	800	100/-	360	100
2N3904	TO-92(5)	nS	40	200	100/300	310	300
2N3906	TO-92(5)	pS	40	200	100/300	310	250

p—pnp, n—nnp, G—germanium, S—silicon

TRANSISTOR OUTLINES AND CONNECTION DETAILS





DO YOU EVER NEED A FEW MORE HANDS? ... IF SO

The new and improved

MINIBENCH*

System

will add a new dimension to your hobby

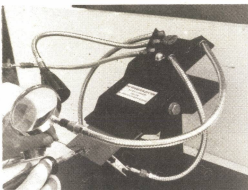
PRICE LIST

	£	p	£ p
Minibench Standard model	15.95	1.75	
Delux model with powder coated finish	17.95	1.75	
Delux model with rotating turn-table base on free-standing mount (as illustrated)	32.50	3.00	
Flexi-Arm - 12"	4.75	15	
- 18"	5.50	15	
Lens Attachment - 50mm lens	2.50	15	
- 75mm lens	3.25	20	
- 100mm lens	5.00	30	
Clip Attachment - Large	2.00	-	
- Small	1.25	-	
Light Fitting with 18" F/Arm	7.50	20	
Transformer Unit mains to 12V 1A	10.50	75	
Complete with switch	12.00	1.75	
Foot Pedal with cable Assy for independent jaw operation	12.00	1.75	

Quantity discounts available for orders of 10 Minibenchs or more: please enquire.

We do endeavour to keep prices stable and absorb increases by outside suppliers where we can but since this is not possible in every case, the prices quoted are subject to alteration without notice.

PLEASE ADDRESS ALL ORDERS TO:
Please allow 14 days for delivery.



Pat App for

*Trade Mark

- * Just a squeeze to clamp or release circuit board
- * Adjustable minimum jaw aperture
- * Jaws flip over for work on either side of circuit board
- * Rubber lined jaws for circuit board protection to maximum grip
- * Single wing nut controls jaw attitude and friction setting
- * Crocodile clips mounted on flexi-arm hold components exactly where needed
- * Crocodile clip can be used as a heat shunt
- * Lens similarly mounted is ideal for close work and spotting those solder bridges
- * Flexi-Arms keep station with circuit board
- * Stove enamelled or powder coated finish
- * Built to last a lifetime!

NOW WITH . . .

- * WHISPER SMOOTH ACTION
- * EXTENDED RANGE OF ATTACHMENTS

SALES DEPT., ABSONGLEN LTD., PO BOX 13, HERFORD HR1 1EA

semiconductor News

OPTO-ELECTRONICS

Seven segment displays designed for viewing up to 30 feet away are now available from Litronix. These 20mm displays, the DL-3400 series, are pin for pin compatible with the HP 508 25400 series and are designed for use in such applications as clocks, point of sale equipment, and other similar systems.

The latest idea in seven segment display counter-decoder-drivers has just been introduced by Intel. This is the ICM7208 and is manufactured using a low voltage metal gate CMOS process.

The most interesting feature of this new device is the fact that not only does it feature low power consumption (10mW maximum) and combine counting, decoding, and display driving circuits, but it also runs no less than seven separate seven segment displays. This means that such functions as multiplexing, display blanking, reset, input inhibit and so on are also included on

the chip.

For simple counter unit applications the chip requires only the addition of displays and a handful of resistors and capacitors to build a fully operational system.

A new departure in panel lamps has just been introduced by Hewlett-Packard and consists of an I.E.D. with a reverse current protection diode and series resistor contained in a single package.

Two versions are available—the HLMP-3105 designed for 5V operation and HLMP-3112 designed for 12V operation.

Both lamps use I.E.D. chips made from Gallium Arsenic Phosphide on a Gallium Phosphide substrate and emit red light (yellow and green devices are also available) and the wide 90 degree viewing angle allows them to be used in many display and control panels without the operator position relative to the panel being too critical.

CRYSTAL DATA

A M-Tron data sheet which includes a cross reference chart for Microprocessor Quartz Crystals is available from MCP Electronics Ltd., Dept EE, 35 Rosemont Road, Alpertown, Wembley, Middlesex, HA0 4PE.

MCP is sole UK agent for the M-Tron range of quartz crystals which encompasses a group of commonly used microprocessor clock crystals, as well as the facility to produce to specification any crystal within the range 1 to 170MHz.

DYNAMIC MEMORY

Another new chip from Intel is the 2164, a 64K by 1-bit dynamic RAM. It is manufactured using the company's well proven HMOS process and comes in an industry standard 16-pin D.I.L. package. Maximum access time is 200ns and the device is pin compatible with the earlier 2118 16K bit RAM.

SERVO AMPLIFIER

Electronic control in industry is an expanding market and Ferranti Electronics have just extended their product range with a new low cost servo amplifier i.c.

This is the ZN409CE and is offered in a standard 14-pin D.I.L. package. The company already manufactures the well known ZN419 but this suffers from "over the odds" pricing because of its non-standard miniature packaging. The new i.c. is identical in specification to the ZN419 but 25 per cent cheaper.

This allows memory upgrade to 64K merely by substituting the new chip and adding one additional multiplexed address line.

According to Intel, "The advent of the 64K dynamic RAM device will allow system designers to incorporate more memory into a system without increasing its physical size".

NEW · NEW · NEW · NEW PRODUCTS NEW · NEW · NEW · NEW

CLEAN CAR

Recognising the number of car cassette players now in use, Bib Audio/Video Products have recently introduced a useful car cassette head cleaning system, which is suitable for use on all cassette players.

The Bib cleaning system comprises a non abrasive cleaning tape, housed in a standard cassette, together with tape head cleaning fluid in a spray can.

The recommended retail price is £4.99, including VAT, and the items are conveniently packed in a handy storage wallet which can be kept in the car glove compartment.

Bib Audio Video Products Ltd, Dept EE, Kelsey House, Wood Lane End, Hemel Hempstead, Herts HP2 4RQ.

ELECTRONIC DOORMAN

Available in several versions, The Electronic Doorman entry phone from Parkway Electronics is an ideal security system for offices, flats, houses and other buildings.

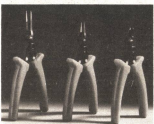
For flats and offices the equipment can operate via a porter's or receptionist's control panel, catering for an unlimited number of units. At the other end of the scale there is a "mini" system specially designed for houses. It is supplied as a complete individual kit which, it is claimed, is easy to install and operate.

Parkway Electronics Ltd, Dept EE, Parkway, Royston, Herts SG8 8EE.



GETTING A GRIP

A set of three small hand-tools fitted with cushion-grip handles have been added to the range of tools offered by Tele-Production Tools.



The set consists of a flush cutting side cutter, with the cutting head angled at 45 degrees, and two fine nosed pliers. The tools are available at a cost of £10 per set or £3.75 each, inclusive of post and packing and VAT.

Tele-Production Tools Ltd, Dept EE, Siron House, Electric Avenue, Westcliff-on-Sea, Essex SS0 9NW.

SERVICE WALLET

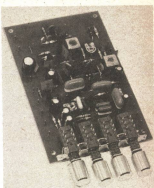
The new service wallet from Toolmail is designed for work on all electronic equipment including computers, video and audio units.

The zipper wallet contains 25 branded miniature tools made up of: miniature soldering iron, desolder braid, solder, soldering tools, range of screwdrivers, pliers, cutters, wire stripper, i.e. extractor and scissors.



The kit costs £39.50 including VAT with free postage anywhere in the UK.

Toolmail Ltd, Dept EE, Parkwood Industrial Estate, Sutton Road, Maidstone, Kent ME15 9LZ.



STEREO FM TUNER

The latest Bi-Kit Stereo FM Tuner module board from Bi-Pak Semiconductors comprises varicap tuning and a phase locked loop decoder for the reception of mono or stereo broadcasts.

Pushbutton switches enable the selection of four pre-tuned frequencies or stations, the selected frequencies being tuned by multiturn potentiometers. Provision exists for the addition of an l.e.d. stereo indicator, a centre zero tuning meter and a mono/stereo switch.

The ready built S.453 module is supplied complete with installation instructions and costs £22.35 including VAT and post and packing.

Bi-Pak Semiconductors, Dept EE, PO Box 6, Ware, Herts SG12 9AG.



CHARGE-UP COST DOWN

Now available in the UK is the Gould "Again & Again" rechargeable battery system, claimed to offer a low cost, re-usable alternative to expensive alkaline batteries.

The Gould nickel cadmium battery system includes all the popular battery sizes and an easy-to-use battery

charger. The charger will take all the batteries in the "Again & Again" range, including the PP3 type.

It is claimed that for an outlay of around £15, a consumer can buy a set of batteries and a charger which will typically provide power for up to five years.

Gould Battery Division, Dept EE, Raynham Road, Bishop's Stortford, Herts CM23 5PF.

Multicore makes soldering easy fast & reliable

Ersin Multicore

Ersin Multicore, solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required. Comes in handy dispensers and tool box reels in two different alloys 40/60 tin/lead for general purpose electrical soldering and 60/40 tin/lead ideal for small components and fine wire soldering.



Size 3 40/60 tin/lead
£4.37 Per reel 1.6mm dia

Size 10 60/40 tin/lead
£4.37 Per reel 0.71mm dia



Size PC115 60/40 tin/lead
£1.38 Handy pack 0.028mm dia

Size 19A 60/40 tin/lead
£1.15 Handy pack 1.2mm dia

Multicore Savbit

Multicore Savbit, solder contains 5 cores of copper erosion reducing flux, increases the life of your soldering bit by 10 times, for better soldering efficiency and economy. Comes in two handy dispensers and tool box reels.



Size 12 Savbit
£4.37 Per reel 1.2mm dia

Size 5 Savbit
£1.15 Per pack 1.2mm dia



Size SV130 Savbit
£1.73 Per pack 0.068mm dia

Multicore Alu-Sol

Multicore Alu-Sol, solder contains 4 cores of flux, suitable for most metals especially aluminium. Comes in handy dispensers and tool box reels.

Size AL150 Alu-Sol
£2.07 Per pack 0.68mm dia



Size 4 Alu-Sol
£7.82 Per reel 1.6mm dia



Multicore Solder Wick

Multicore Solder Wick, absorbs solder instantly from tags and printed circuits with the use of a 40 to 50 watt soldering iron. Quick and easy to use, desolders in seconds.

Size AB10 Solder Wick
£1.43 Per pack



Multicore Tip Kleen

Multicore Tip Kleen, soldering iron tip wiping pad. Replaces wet sponges.



Size 2 Tip Kleen
£0.92 Per pack

Bib Wire strippers and cutters

Wire strippers and cutters, with precision ground and hardened steel jaws. Adjustable to most wire sizes. With handle locking-catch and easy-grip plastic covered handles.



Size 9 Wire Strippers
£2.69 Per pair

All prices inclusive of VAT.

Available from most electrical and DIYs stores. If you have difficulty in obtaining any of these products send direct with 50p for postage and packing. For free colour brochure send S.A.E.

Bib Audio/Video Products Limited
(Solder Division), Kelsey House,
Wood Lane End, Hemel Hempstead,
Hertfordshire, HP2 4RQ.
Telephone: (0442) 61291
Telex: 826437

MASTER ELECTRONICS NOW!

The PRACTICAL way!

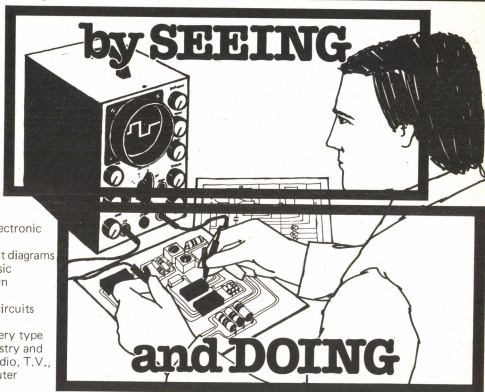
This new style course will enable anyone to have a real understanding of electronics by a modern, practical and visual method. No previous knowledge is required, no maths, and an absolute minimum of theory.

You learn the practical way in easy steps mastering all the essentials of your hobby or to start or further a career in electronics or as a self-employed servicing engineer.

All the training can be carried out in the comfort of your own home and at your own pace. A tutor is available to whom you can write personally at any time, for advice or help during your work. A Certificate is given at the end of every course.

You will do the following:

- Build a modern oscilloscope
- Recognise and handle current electronic components
- Read, draw and understand circuit diagrams
- Carry out 40 experiments on basic electronic circuits used in modern equipment
- Build and use digital electronic circuits and current solid state 'chips'
- Learn how to test and service every type of electronic device used in industry and commerce today. Servicing of radio, T.V., Hi-Fi and microprocessor/computer equipment.



New Job? New Career? New Hobby? Get into **Electronics** Now!

FREE!

COLOUR BROCHURE



Please send your brochure without any obligation to

I am interested in:

NAME _____

☐ COURSE IN ELECTRONICS
as described above

ADDRESS _____

☐ RADIO AMATEUR LICENCE

☐ MICROPROCESSORS

☐ LOGIC COURSE

OTHER SUBJECTS _____

POST NOW TO:

BLOCK CAPS PLEASE

EE/01/820

British National Radio & Electronics School Reading, Berks. RG1 1BR.

TRULY PORTABLE

Hitachi claim, that never before have so many advances been made in a new video model than with the Hitachi VT6500 portable video system. "It's portable video, that's truly portable."

The new model will appeal to the enthusiastic cine user as now it is possible to electronically edit a recorded video tape. It has pulse control editing that ensures that scene changes and overlays are clean and in sync with no distortion or electronic "snow" at the critical points.

Besides clean picture editing, the sound can be varied

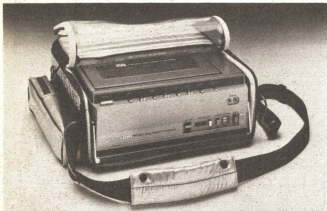
PERSONAL COMPUTER

The new Atari 400 and Atari 800 personal computers are now on sale in the UK, under an exclusive franchise with Ingersoll Electronics.

It is claimed that even those who are hesitant about owning a home computer can have these machines "humming" in minutes.

The suggested retail price for the Atari 800 is £645 including VAT and the Atari 400 £345, including VAT.

Ingersoll Electronics Ltd,
Dept EE, 202 New North
Road, London N1 7BL.



too. Most video recorders provide an audio dub facility which replaces the original sound track with new sound, but the VT6500 goes a stage better by enabling the user to blend new sound material with the original sound track and not replace it, although this is still possible.

The VT6500 is supplied with remote control unit, r.f. cable, earphone, cassette tape, shoulder bag and battery for the sum of £677 including VAT.

Hitachi Sales (UK) Ltd,
Dept EE, Hitachi House,
Station Road, Hayes,
Middlesex UB3 4DR.



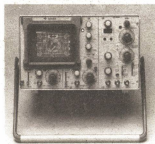
TV SCOPE

A 30MHz dual trace, TV monitoring oscilloscope, made under licence by Gould, incorporates a BBC-designed timebase module to

provide a wide range of video triggering and display modes for the monitoring and measurement of broadcast television signals.

The OS3351 oscilloscope has a 16kV cathode ray tube to give a bright display of video waveforms, and the timebase generator allows the instrument to be used for the line-by-line examination of 625-line television waveforms or to display a complete TV picture. The line number selected for display is indicated on a 3-digit I.e.d. display on the front panel.

Gould Instruments Division,
Dept EE, Roebuck
Road, Hainault, Essex
IG6 3UE.



in
My Class

by
T.R. de Vaux-Balbirnie

We use a lot of single-strand connecting wire with p.v.c. insulation for circuit building. Gerald

had an unhappy knack of breaking the core. On this occasion he was securing it under the terminal of a lampholder when the end fell off.

I decided to find out what he was doing wrong and discovered that he was stripping the insulation with ordinary side cutters. I must admit that I do this myself and he must have picked up the habit. I explained that when I do it I am careful to squeeze the handles only enough to cut the insulation and no more.

With experience this is possible. If any greater pressure is applied then a "nick" will be made in the core. If this is at all deep then the wire will break soon afterwards. If only slightly scored, the core will break later, probably at a very inconvenient time.

I told the whole class that it was far safer to use the special wire strippers which are adjustable for the type of wire. When correctly "set" they will cut the insulation but not the core.

I decided always to use the strippers myself when demonstrating to the class and to avoid also the habit of using my teeth!

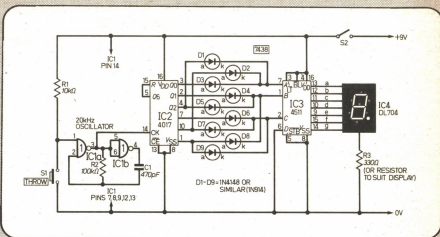
I explained to the class that one rather thick single core was very fragile and that stranded wire should always be used when the wire was subject to much bending. Wire made from many thin strands was flexible and could be used for headphone leads and the like where bending could be expected. On the other hand, stranded wire was very difficult to push into the holes of circuit boards unless twisted and tinned.

CIRCUIT EXCHANGE

DIGITAL DIE

This die circuit provides a variation on a theme in that it uses a seven segment numeric display instead of a seven dot array to present its result.

The design is based around a decade counter i.c. which is clocked by a 20kHz oscillator consisting of two NOR gates and an R-C network. The counter output state when the "throw" switch is released is encoded into a binary input by the diode matrix D1-9 which is then converted to the seven segment display by the decoder/driver i.c., the 4511.



The brightness of the display may be varied by adjusting the value of R3 slightly.

When the "throw" button is depressed the display will appear as an

"8" as the numbers change in rapid succession.

D. Butler,
Colchester,
Essex.

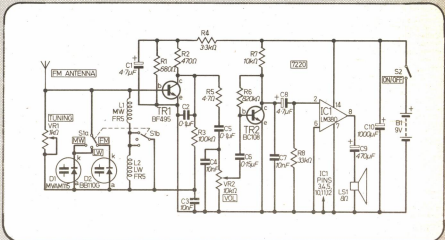
AM/FM VARICAP RADIO

The circuit shown here is for a basic varicap diode AM/FM tuner. Instead of using a variable capacitor in parallel with the tuning coils to pick up the radio signal, a capacitive semiconductor device known as a varicap diode is used in conjunction with a potentiometer.

The audio frequency end of the receiver utilises an LM380 i.c. amplifier and power is from a 9V battery.

This type of radio is simple to build as there are no complicated setting up procedures and tuning is easy and quite accurate.

R. Creed,
Ruislip,
Middlesex.

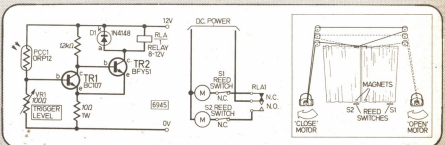


LIGHT OPERATED CURTAINS

Readers may be interested in my idea for a circuit for the use of opening and closing curtains when no one is at home.

The circuit is a light activated switch which operates a relay which switches on the curtain motors via reed switches S1, S2. The light dependent resistor PCC1 and VR1 provide the bias for the base of TR1 which triggers the transistor TR1 on at a predetermined level set by VR1. TR2 is switched on by the operation of TR1 and activates the relay RL1.

The light dependent resistor should be placed close to the window glass, or even on an outside wall, so when darkness falls the relay can be operated. The motors are placed at the left and right of the curtain using fishing line and pulleys attached to the curtains. See sketch.



The reed switches S1, S2, and magnets are used to cut off the motors when the curtains are fully drawn back. The reed switches should be the changeover type wired in a normally closed position.

If mains is used, then the motors and switches must be changed to suit. A mains 12V transformer is advisable for prolonged use.

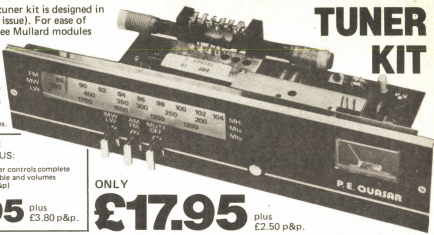
Michael Johnson,
Wilmslow, Cheshire.

CIRCUIT EXCHANGE

NEW PRACTICAL ELECTRONICS - STEREO TUNER KIT

This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.

FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size 10 1/2" x 2 1/2" approx. Complete with diagrams and instructions.



SPECIAL OFFER! TUNER KIT PLUS:

- Matching I.C. 10-10 Stereo Power amplifier kit (usually £2.95 + £1.15 p&p)
- Mullard LP1183 built preamp, suitable for ceramic and auxiliary
- Attractive black vinyl finish cabinet, 9" x 8 1/2" x 3 1/2" (approx)
- Matching power supply kit with transformer (usually £2.00 + £1.95 p&p)

- Matching set of 4 slider controls complete with knobs for bass, treble and volumes (usually £1.70 + 80p p&p)

£21.95 plus £3.80 p&p.

ONLY

£17.95 plus £2.50 p&p.

STEREO AMPLIFIER KIT

- Featuring latest SGS/ATES TDA 2006 10 watt output IC's with in-built thermal and short circuit protection.
- Mullard Stereo Preamp/Module.
- Attractive black vinyl finish cabinet, 9" x 8 1/2" x 3 1/2" (approx)
- 10-10 Stereo Power supply to a 20 watt Disco amplifier.

To complete you just supply connecting wire and solder. Features slide in input sockets for ceramic cartridge, microphone, tape or tuner. Outputs - tape, speakers and headphones. By the press of a button it transforms into a 20 watt mono disco amplifier with twin dynamic inputs. The kit incorporates a Mullard LP1183 pre-amp module, plus power amp assembly kit and mains power supply. Also features 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia with matching knobs and contrasting cabinet. Instructions available, price 50p. Supplied FREE with the kit.

£14.95
Plus £2.90 p&p.

SPECIFICATIONS: Suitable for 4 to 8 ohm speakers.
40Hz - 20KHz.
P.U. 150mV, Aux. 200mV.
Mic. 1.5mV.
Bass ±12dB @ 60Hz
Treble ±12dB @ 10KHz
0.1% typically @ 8 watts
220 - 250 volts 50Hz.

Tone controls
Distortion
Mains supply

STEREO MAGNETIC PRE-AMP CONVERSION KIT

Includes FREE Magnetic cartridge with diamond stylus. All components including p.c.b. to convert your ceramic input on the 10-10 to magnetic. Only available with 10-10 amp. **£2.00** includes p&p.

8" SPEAKER KIT Two 8" twin cone domestic speakers. £4.75 per stereo pair plus 10 p&p, when purchased with amplifier. Available separately £5.75 plus £1.70 p&p.

PRACTICAL ELECTRONICS CAR RADIO KIT SERIES II

2 WAVE
BAND
MW - LW

- Easy to build
- 5 push button tuning + Modern design
- 6 watt output + Ready etched and punched PCB + Incorporates suppression circuits.

All the electronic components to build the radio, you supply only the wire and the solder, featured in Practical Electronics March issue. Features: pre-set tuning with 5 push button options, back illuminated tuning scale. The P.E. Traveller has a 6 watt output reg. ground and incorporates an integrated circuit output stage. A Mullard IF Module LP1181 ceramic filter type pre-aligned and assembled, and a Bina pre-aligned push button tuning unit.

Suitable stainless steel fully retractable aerial (locking) and speaker (6" x 4" approx.).
£10.10 plus £2.00 p&p.
available as a kit complete. **£1.95/pack.** Plus £1.15 p&p.

HIGH POWER AMPLIFIER MODULES

READY BUILT OR IN KIT FORM

	KIT	BUILT
125 WATT MODEL	£10.50 Plus £1.15 p&p	£14.25 Plus £1.15 p&p.
200 WATT MODEL	£14.95 Plus £1.15 p&p	£18.95 Plus £1.15 p&p.

SPECIFICATIONS:
Max. output power (RMS)
Operating voltage (DC)
Loads
Frequency response
measured @ 100 watts
Sensitivity for 100 watts
Typical T.H.D. @
50 watts, 4 ohms
Dimensions (both models)
205 x 90 and 190 x 36mm.
The power amp kit is a module for high power applications - disc units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of

generously rated components, result, a high powered rugged unit. The PC Board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is performed and ready to use. Supplied with all parts, circuit diagrams and instructions.

ACCESSORIES:

Suitable LS coupling electrolytic for 125W model	£1.00 plus 25p p&p.
Suitable LS coupling electrolytic for 200W model	£1.25 plus 25p p&p.
Suitable mains power supply unit for 125W model	£7.50 plus £2.15 p&p.
Suitable Twin transformer power supply for 200W model	£13.95 plus £4.00 p&p.

30+30 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet, silver finished rotary controls and pushbuttons with matching fascia, mains indicator and stereo jack socket. Functions switch for m.c. magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder, DIN speaker and input socket 30+30 watts RMS, 60-60 watts peak. For use with 4 to 8 ohm speakers.
Size 14 1/2" x 10" approx.
£32.90
Plus £3.80 p&p.

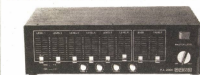
TV SOUND TUNER KIT

as featured in E.T.I. December '81 issue. Kit of parts including PCB, UHF tuner, I.C.'s, all components excluding case, and selector switch. **£11.45 + £1.50 p&p.**



• Transformer £1.50 + £1.50 p&p (p&p free on transformer if ordered with kit). • Ready built LP1183 Module for simulated stereo operation. **£1.95 + 75p p&p.**

MONO MIXER AMPLIFIERS



50 WATT Six individually mixed inputs for two pick ups (Cer. or Mag.), two moving coil microphones and two auxiliary for tape, tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic and aux inputs. Size: 13 1/2" x 6 1/2" x 3 1/2" approx. Power output 50 watts R.M.S. (continuous) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

£39.95
Plus £3.70 p&p.



100 WATT brushed Aluminium fascia and rotary controls.
Size: approx. 14 1/2" x 10 1/2" x 3 1/2".
Five vertical slider controls, master volume, tape level, mic level, deck level, PLUS INTERDECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PFL) lets you hear the next disc before fading it in.
VU meter monitors output.
100w RMS output (200w peak).
£76.00
Plus £4.80 p&p.

RTVC

CALLERS ONLY
323 Edgware Rd, London W2. Tel: 01-723 8432.
Open 9.30am - 5.30pm. Closed all day Thursday.
Persons under 16 not served without parents authorisation.

ALL PRICES INCLUDE VAT AT 15%.

MAIL ORDER ONLY
21A HIGH STREET, ACTON, W3 6NG.
Note: Goods despatched to UK postal addresses only. For further information send for instructions 20p plus stamped addressed envelope.

All items subject to availability. Prices correct at 1/10/80 and subject to change without notice. RTVC Limited reserve the right to update their products without notice.

Sinclair ZX81 Personal Computer

the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

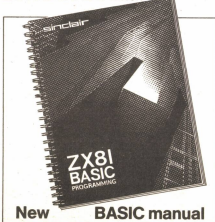
Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability

With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, and to drive the new ZX Printer.



Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.⁹⁵

Higher specification, lower price – how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.

- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.

- Unique syntax-check and report codes identify programming errors immediately.

- Full range of mathematical and scientific functions accurate to eight decimal places.

- Graph-drawing and animated-display facilities.

- Multi-dimensional string and numerical arrays.

- Up to 26 FOR/NEXT loops.

- Randomise function – useful for games as well as serious applications.

- Cassette LOAD and SAVE with named programs.

- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.

- Able to drive the new Sinclair printer.

- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.



Built: £69.⁹⁵

Kit or built – it's up to you!

You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



Everyday Electronics, January 1982

uter-



16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.



Available now- the ZX Printer for only £49.⁹⁵

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumeric and highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further instructions.

At last you can have a hard copy of your program listings – particularly

useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you can plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call

01-200 0200 for personal attention 24 hours a day, every day.

BY FREEPOST – use the no-stamp-needed coupon below. You can pay

by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY.				Order
Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95
☐ Please tick if you require a VAT receipt				TOTAL £
*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £				
*Please charge to my Access/Barclaycard/Trustcard account no.				
*Please delete/complete as applicable.				
Name: Mr/Mrs/Miss				
Address:				
FREEPOST – no stamp needed. Offer applies to UK only.				
EVE 01				

sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

Everyday Electronics, January 1982

Team Up With Electronics

for top quality components, innovative kits,
FAST SERVICE AND LOW, LOW PRICES

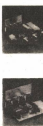
TEACH-IN '82

EE Minilab £13.50
Kit of components for parts 1 to 6
Special Price if above kits purchased
together £19.99
The above kits include all the components
specified in the Teach-In '82 projects parts 1-5
plus sockets for ICs required. Don't forget to
send the Vero Z1 voucher for a further dis-
count. Prices do not include VAT.

DISCO LIGHTING KITS

Each unit has 4 channels (rated at 1KW at
240V per channel) which switch lamps to
provide sequencing effects, controlled
manually or by an optional opto isolated
audio input.

DL1000K £69.99
This kit features a bi-
directional sequence, speed
of sequence and frequency
of direction change being
variable by means of poten-
tiometers. Incorporates
master dimmer control! £14.99
DL12000K £69.99
A lower cost version of the
above featuring unidi-
rectional channel sequence
with speed variable by
means of a preset pot. Out-
puts switched only at mains
zero crossing points to re-
duce radio interference to
minimum £39.99
Opto Opto Input DLAT £69.99



VOLTAGE REGULATORS

Available in 5V, 18V & 25V
versions.
78L series 100mA peak 15p
78L series 100mA peak 35p
78L series 1A peak 60p
79 series 1A peak 50p
79 series 1A peak 50p
LM317T adjustable 1.2V-37V 1.5A £1.99

ELECTRONIC JOKER

Put up with your
old dice? This kit should
cheer you up!
Our latest kit gives
you a pleasing three
note harmonically rela-
tive sequence
(NOT a metronome)
control and is a touch
of a button.
Controlled by a new integrated
circuit, this kit is supplied
sounded in a pre-set loud-
speaker and drive foot
board, loudspeaker and drive foot
board, and requires only a 9V battery
and a push-button, which you've
probably already got.
It may also be switched by logic in
your computer or an alarm, clock,
stop, PA systems, etc. The unit produces
a 150mV output and draws less than
1uA from a 9V battery, when the tone
causes. Supplied complete with circuit and
assembly instructions.

IDEAL PROJECT FOR BEGINNERS
ONLY £5.00 + V.A.T.

YOU MUST HAVE BETTER THINGS TO DO

then getting up to switch lights on when
it's dark. Our Lamp Dimmer Kit with
INFRA RED REMOTE CONTROL will
enable you to switch the lights on or off,
and set the brightness, at a push of a
button without leaving your armchair,
water-bed, etc. Not only will you save
time but it has also been estimated that
the savings in shoe leather and carpet
wear alone would pay for this unit in
approximately 1.3657 years or more!!



This unit has, of course, considerable
practical uses, especially for the old
infirmary and disabled. It works like a
conventional dimmer, enabling you to
switch the lights on or off or to dim
them to whatever brightness you re-
quire, by touch or remotely using the
hand-held infra red transmitter. When
assembled, it fits into a plaster depth
box to replace your conventional
switch or dimmer with no rewiring.

TOR300K Dimmer Kit £14.30
and **MKS Transmitter Kit** £4.20
We also still offer our highly popu-
lar **TD300K Touch Dimmer Kit**
at £7.00 and the **LD300K rotary**
controlled Dimmer Kit at only
£3.50 (plus VAT to above
prices).
All kits contain all necessary
components and full assembly
instructions. You only need a
soldering iron, cutters and a few
hours.



DVM/THERMISTOR KIT

Based on the ICL7106 (a low power version of the ICL7109 chip) and a
3 1/2 digit liquid crystal display, this kit will form the basis of a digital
multimeter (only a few additional resistors and switches are required
—details supplied), or a sensitive digital thermometer (-50°C to
+150°C) reading to 0.1°C. The basic kit has a sensitivity of 200mV for
full scale readings, automatic polarity indication and an ultra low
power requirement—giving a 2 year typical battery life from a standard
9V PP3 when used 8 hours a day, 7 days a week. £15.99 + VAT

TRIACS

400V Plastic Case (Texas)
8A TIC268D £49p
8A TIC268D £49p
12A TIC268D £59p
16A TIC268D £69p
25A TIC268D £89p
8A with trigger 0A000LT £9p
8A isolated tab T0A000LT £19p
Opto isolated triac MOC3020 0-6A/400V £19p

MINI KITS

These kits form useful subsystems which
may be incorporated into larger designs or
used alone. Kits include PCB, short
instructions and all components.
**MKS TEMPERATURE CONTROLLER/
THERMOSTAT** £4
Uses LM3801 IC to sense temperature
(-50°C max) and triac to switch heater.
MKS SOLID STATE RELAY £4
Ideal for switching motors, lights, heaters,
etc., from logic. Opto-isolated with zero
voltage switching. Supplied without
triac. Select the required triac from our
range. £2.99

MKS BAR/DO DISPLAY £4.75
Displays an analogue voltage on a linear
10-element LED display as a bar or single
dot. Ideal for thermometers, level indica-
tors, etc. May be stacked to obtain 20 to
100 element displays. Requires 5-20V
supply.

**MKS PROPORTIONAL
TEMPERATURE CONTROLLER** £4.75
Ideal for switching motor, lights, heaters,
etc. This kit may be wired to form a burst
fire power controller, enabling the temperature
of an enclosure to be maintained within
0-5°C. Thermistor failure causes output
to switch off. Temperature range ambient
to 90°C. 3KW. £3.99

MKS MAINS TIMER £3.99
Based on the ZN1034E Timer IC this kit
will switch a mains load on (or off) for a
preset time from 20 minutes to 38 hours.
Longer or shorter periods may be realised
by minor component changes. Maximum
load 1KW. £4.99

WEBB ELECTRONICS

BURGLAR ALARM INSTALLATIONS & ELECTRONIC COMPONENTS
BURGLAR ALARM EQUIPMENT.

41 WINWICK STREET, WARRINGTON, CHESHIRE
Tel: Warrington SA174.

CONTROL PANELS

1 Battery/mains £32.50
2 Extent, Battery/mains, timed entry-
exit timers £45.00
British Standard panels to order

CABLE

3 4-core 100m £9.00
4 6-core 100m £14.00
5 Lacing wire 250m £3.90

CABLE FITTINGS

6 Clips 3-5mm 64p
7 Clips 5mm 64p

CONTACTS

8 Small flush 4-wire 79p
9 Flush 1/2" quickfit 5 screw 95p
10 Surface 5 screw £1.09
11 Aluminium (Patio) £1.81

PRESSURE MATS

12 Stair mat 22 1/2" x 64" £1.17
13 Standard mat £1.72

PERSONAL ATTACK

14 Plastic £2.15
15 Metal £3.15

JUNCTION BOXES

16 White or ivory 6-way 22p

DOOR LOOPS

17 Complete white or ivory 83p
18 6-core type 94p

BELLS & SOUNDS

19 Friedland 'Master' bell £13.75
20 12v Carter's Minimitre rotary siren £7.50
21 2-tone electronic horn £10.76
22 12v buzzer £1.00

SPACE PROTECTION

23 PE Beams to order £45.00
24 Passive infra red 8m £35.00
25 Passive infra red 12m £35.00
26 UltraSonics & long range passives
to order

BELL BOXES

27 'B' type (smaller) £5.90
28 'C' type £7.00

METAL BOXES

hinged hswg £6.33
29 9" x 6" x 3" £7.17
30 12" x 9" x 3"
31 Autodiallers to order

WINDOW PROTECTION

32 Window foil aluminium 50m £2.00
33 Foil Blocks double, will separate 22p

BATTERIES

34 Rechargeable 12v 2-6ah £10.50
35 HP992 dry 6v £2.30

ANCILLARIES

36 Microswitch long lever 62p
37 SP pass switch £3.00
38 DP pass switch £4.43

All prices are inclusive of VAT. P. & p. £1.50 total.
ALARM EQUIPMENT—RETAIL
All Goods By Return of Post.

It's easy
to claim
about
advertisements.

The Advertising Standards Authority.
If an advertisement is wrong, we're here to put it right.
ASA Ltd, Brook House, Ippington Place, London WC1E 7HN.

NEW KITS

COMBINATION SWITCH

Battery operated, would control solenoid lock or any electrical device, virtually impossible to decode. Uses no power when in the off position. Complete kit £4.90.

A SECRET SWITCH

Cuts a hidden behind a panel, door, wallpaper, etc. Will light the lamp or whatever device is secretly controlled and it will also latch itself on. Complete kit £1.95.

3-30V VARIABLE VOLTAGE POWER SUPPLY UNIT

With 1 amp DC output, for use on the bench, testers, inductors, service engineers, etc. Automatic short circuit and overload protection. In case with a volt meter on the front panel. Complete kit £13.90

IONISER KIT

For your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder - complete mains powered kit, case £11.95, post £1.50.

BIG AMPLIFIERS

Complete kit (no case) 40 watt £9.50, 115 watt £13.50.

T.V. AERIAL FILTER

Designed to eliminate C.B. and other interference complete

MORSE TRAINER

Complete kit £2.95.

DRILL SPEED CONTROLLER

Complete kit £3.95.

MAINS POWER SUPPLY

Gives any voltage from 2V to 16V at up to 300mA. Complete kit less case £1.95, Case 90p.

HOME BASE POWER SUPPLY

15V 20amp - built and regularly used by G3CJ, has all the features including overload protection tripe, 500 watt transformer and all parts included case £39.50 carriage £5.

AERIAL DIRECTION INDICATOR

Kit includes 16 red switches, magnet, 16 i.a.e. and chart which has the 16 compass points and lights up where your aerial is pointing. £5.90

AERIAL ROTATOR

Comprises like motor with pulley and vee belt, electro-mechanical aerial base unit and control switch enables you to set your aerial mass in any direction. £19.50 carriage £5.

SUPER HI-FI SPEAKER CABINETS

Made for an expensive Hi-Fi outfit - will suit any decor. Resonance free, cut-outs for 6 1/2" woofer and 3 1/2" tweeter. The front material is Dacron. The completed unit is most pleasing. Applied in pairs, price £5.90 per pair (this is probably less than the original cost of one cabinet) carriage £3.00 the pair.

GOODMAN SPEAKERS

6 1/2" x 2 1/2" £4.50, 2 1/2" x 1 1/2" £2.50. No extra for postage if ordered with cabinets. Xover £1.50.

Vu METER SNIP.

Approximately 1 5/8" square, suitable for use as a recording level meter - power output indicator or among similar applications. Full vision front, cover easily removable if you wish to alter the scale. Special snip price £1.00, or 10 for £9.50.

MOTORISED DISCO SWITCH

With 10 amp changeover switches. Multi-adjustable switches all rated at 10 amps, this would provide a magnificent display. For mains operated 8 watt model £6.25, 10 switch model £6.75, 12 switch model £7.25.

12V MOTOR BY SMITHS

Made for use in cars, these are series wound and they become more powerful as load increases. Size 3 1/2" long by 3 1/2" dia. These have a good length of 3/8" spindle - price £2-45. Otto, but double ended £4.25.

EXTRA POWERFUL 12V MOTOR

Made to work battery lawnmower, this motorable develops up to 3 h.p., so it could be used to power a go-kart or to drive a compressor, etc. etc. £6.90 + £1.50 post.

UNIVAC KEYBOARD BARGAIN

50 computer type keys, together with 5 miniature toggle switches all mounted on a p.c.b. together with 12 i.c.'s, many transistors and other parts. £13.95 + £2.00 post. This is far less than the value of the switches alone. Diagram of this keyboard is available separately. Price £1.00.

SOLENOID WITH PLUNGER

Mains operated £1.99 10 - 12 volts DC operated £1.50.

MULLARD UNILEX

A mains operated 4 + 4 stereo system. Based one of the finest performers in the stereo field this would make a wonderful gift for almost anyone, but in case you do not have the time or money to buy this month we offer the system complete at only £16.75 including VAT and post. FREE GIFT - Buy this month and you will receive a pair of Goodman's elliptical 8"x8" speakers to match this amplifier.

3 CHANNEL SOUND TO LIGHT KIT

Complete kit of parts for a 3 channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish it a plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by 1/4" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is £14.95 in kit form or £25.90 assembled and tested.

THIS MONTH'S SNIP

STROBE LIGHT

Intended for use at discos or in window displays etc. Gives a bright flash of white light at a speed which you can vary between approximately 1 flash per second up to 20 flashes per second. Another useful application of a strobe is for looking at rotating wheels, caps, etc. By turning the speed adjustment you can get the light to synchronise with the wheel and it to appear stationary.

You can thus look at a rotating device for its faults, you can see a broken cog for instance. It uses a Xenon tube and is housed in a neat wooden case with the variable control at the back. Works off normal 230V/240V mains - £14.90 + £1 post.

MICRO SWITCH PARCEL

10, all different and including one that can be operated by a puff of wind and another by only 1mm of movement. Also containing lever roll and roller operated subminiature and standard. All new £1.75p.

SPIT MOTORS

These are powerful mains operated induction motors with gear box attached. The final shaft is a 1/2" rod with square hole, so you have alternative coupling methods - final speed is approx. 5 rev/min, price £5.50. Similar motors with final speeds of 100, 160 & 2000 p.m. same price.

EXTRACTOR FAN

Mains operated - fix, compressor.

6" Woods extractor £5.75 Post £1.25

6" Woods extractor £6.90 Post £1.50

5" Pannier extractor £6.50 Post £1.25

4" x 4" Muffin 11.5v. £4.50 Post 50p.

4" x 4" Muffin 230v. £5.75 Post 50p.

8 POWERFUL BATTERY MOTORS

For models, meccanos, drills, remote control planes, boats, etc. £2.50.

TAPE PUNCH & READER

For controlling machine tools, etc., motorised B bit punch with matching tape reader. Ex-computer, believed in good working order, any rest so would be exchanged. £17.50 pair. Post £3.00.

MINI-MULTI TESTER

Deluxe pocket size precision monitoring coil instrument, Jewelled bearings - 2000 p.p.m. mirrored scale. 11 instant range measures: DC volts 10, 50, 250, 1000, AC volts 10, 50, 250, 1000, DC amps 0 - 100 mA.

Continuity and resistance 0 - 1 meg ohms in two ranges. Completes with test leads and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only £8.75 + 50p post and insurance.

FREE Amps range kit to enable you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but if you already own a Mini-Tester and would like one, send £2.50.

FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

TRANSMITTER SURVEILLANCE

Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox - all electronic parts and circuit. £2.30. (Not licencable in the U.K.).

RADIO MIKE

For chess and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6.90 complete kit. (Not licencable in the U.K.).

FM RECEIVER

Made up and working, complete with scale and pointer, needs only a speaker (ideal for use with our surveillance transmitter or radio mike. £5.85.

CB RADIO -

Listen in to your 40 channel monitor. Unique design ensures that you do not miss any order or caller. Complete kit with case, speaker and instructions only £5.99.

NEW ADDRESS FOR CALLERS:-

2, Bentham Road, Off Elm Grove, Brighton, Tel: Brighton 671457. Please phone before making a special journey for any advertised item.

VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs, repeatedly duty automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95. These are new but without case, but we can supply plastic cases (base and cover) £1.75 or metal case with window £2.95. Also available is adaptor kit to convert this into a normal 24hr, time switch but with the added advantage of up to 10 on/off per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.20.

STEREO HEADPHONES

Japanese made of very good quality. 8 ohm impedance, padded, terminating with standard 3 1/2" jack-plug. £2.99 Post 50p.

TIME SWITCH BARGAIN

Large clear mechanism, fully controlled clock, which always shows you the correct time + start and stop switches with the dials. Comes complete with knobs. £2.50.

DELAY SWITCH

Mains operated switch can be accurately set with pointers knob for periods of up to 20hrs. 2 contacts - suitable to switch 10 amps - second contact closes a few minutes after 1st contact. £1.95.

6 WAVEBAND SHORTWAVE RADIO KIT

Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an assembler to connect it to a pair of high resistance headphones. Price £11.95.

MEDIUM & 2 SHORT WAVE CRYSTAL RADIO

All the parts to make up the beginner's model. Price £2.35. Crystal earpiece 65p. High resistance headphones (gives best result) £3.75. Kit includes chains and front but not case.

RADIO STETHOSCOPE

Easy to fault find - start at the aerial and work towards the speaker when signal stops you have found the fault. Complete kit £4.95.

INTERUPTED BEAM

This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components - relay, photo transistor, resistors and caps etc. Circuit diagram but no case. Price £2.30.

MOUDER DETERMINER

A high noise bresper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2.50 complete kit.

TANGENTIAL BLOW HEATER

2.5 Kw quiet, efficient instant heating from 230/240 volts mains. Kits consists of a power is illustrated. 2.5 Kw element, control switch and data all for £4.95, post £1.50.

12V SUBMERSIBLE PUMP

Just join it to your car battery, drop it into the liquid to be moved and up it comes, no measuring about, no priming, etc. and you get a very good head. Suitable for water, paraffin and any non-explosive non-corrosive liquid. One use if you are a camper, make yourself a shower. Price £5.50.

MINI MONO AMP

On p.c.b., size 4" x 2". Three transistors and we estimate the output to be 3 watts rms. Brand new, made up offered at the very low price of £1.15 each or 10 for £10.00.

IBL Electrical Ltd

(Dept. EE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU.

Established 30 YEARS

Please allow up to 28 days delivery.

TYPE	AMPS		PRICE £	P/P £
	30v	60v		
124	1	0.5	3.30	1.43
126	2	1	6.36	1.43
127	4	2	7.86	1.73
125	6	3	11.78	1.90
133	8	4	14.72	2.20
40	10	5	17.10	2.20
120	12	6	19.44	2.35
121	16	8	27.70	4.00
122	20	10	32.05	4.00
189	24	12	37.02	5.00

TYPE	VA	PRICE £	P/P £
415C	50	2.31	0.87
416C	100	3.46	0.87
417C	200	4.00	1.10
418F	350	6.26	1.43
419F	500	6.74	1.73
420E	750	8.33	1.90
421F	1000	11.64	2.05

AC VOLTAGE REGULATORS
AUTOTAP #1 INCLUDED RFI FILTER
AND TRANSIENT SUPPRESSOR IDEAL
FOR COMPUTERS - HIGH AND ALL
SENSITIVE EQUIPMENT
INPUT 100v ~ 18% 20% 50/60HZ
OUTPUT 240v ~ 1-5%
(OTHER INPUT AND OUTPUT VOLT.
AGES AVAILABLE)
AUTOTAP#1 400 VA 472
800 VA 488
+ VAT & £ 75P/P
ALSO AVAILABLE AUTOTAP#1



Reviews, January 1962

THE LATEST CASIO WORLD BEATERS

WE WILL BEAT ANY LOWER ADVERTISED PRICE BY 5% providing the advertiser has stocks

FULL SOFTWARE BACKUP

World's Most Powerful BASIC Pocket Computer

FX-702P

RRP £134.95

ONLY

£119.95

Plus FREE MICROL Professional Programming Pack* (RRP £9.95).

Flattens the Sharp PC1211

Alpha/numeric dot matrix scrolling LCD. Variable input from 1680 steps, 26 memories, to 80 steps, 226 memories, all retained when switched off. Up to 10 programs, Subroutines; 10 levels. FOR/NEXT looping; 8 levels. Debugging and Editing, 55 built-in functions, including Regression and Correlation, all usable in programs. Program/Data storage on cassette via optional FA-2 adaptor (£19.95). Auto Power Off. 17x165x82mm. 176g.

World's Fastest Programmable?

FX-602P

- * LCD alpha/numeric (dot matrix) scrolling display.
- * Variable input from 32 program steps with 88 memories, to 512 steps with 22 memories.
- * Memory and program retention when switched off.
- * Up to 10 pairs unconditional jumps (GOTO).
- * Conditional jumps and count jumps. Indirect addressing. Manual jump.
- * Up to 9 subroutines, up to 9 levels.
- * 50 scientific functions, all usable in programs.
- * PAM (Algebraic) with 33 brackets at 11 levels.
- * Program and data storage on cassette tape using optional FA-2 remote control adaptor, £19.95.
- * Compatible with the FX-501P and FX-502P.
- * 9.6x71x141.2mm. 100g.

ONLY £74.95

(RRP £84.95)

Plus FREE MICROL Professional Programming Pack* (RRP £9.95).

FP-10 MINI PRINTER

For FX-702P, FX-602P, FX-502P, FX-501P.
Available soon. Price and delivery on application.

CASIO FX-702P SOFTWARE

Produced by MICROL exclusively for Tempus
10% discount on software, if you purchase your hardware from us.

MICROL 702 USER SUPPORT

Professional Programming Pack. Get the best from your FX-702P with: PROFESSIONAL PROGRAMMING – practical 702 programming from the ground up plus 702 REFERENCE MANUAL – definitive guide to every 702 program command – INVALUABLE! **MICROL 702PPP.** Price £9.95

Advanced Professional Programming. Create power-packed programs with MICROL's down-to-earth guide to the advanced 702 program commands. Create simple solutions to complex problems! **MICROL 802 APP.** Price £7.95
Available December, 1981.

MICROL 702 APPLICATIONS SOFTWARE

MICROL 702 SuperCalc. At last! The power of a VISICALC-type modelling system in a pocket computer! For all scientific, statistical, business and general computing users, SUPERCALC has to be used to be believed – create powerful programs in minutes – answer 'what if' questions – analyse trends – cut programming time up to 95%. Full range easy-use commands; SAVE/LOAD/PRINT options. FA-2 recommended; FP-10 optional. Full detail User Manual plus Program List for direct entry. **MICROL 702 S/C.** Price £14.95
Available December, 1981.

MICROL 702 Basic:Plus. Add the power of up to 20 new commands to your programs! Custom-made to ease advanced programming – features include: String – number conversions; single-shot, await, timed K&V with user-controlled return values; programmable RAN # generator; DATA PACKING – up to 38 program steps – 2 programs. One independent memory, 6 constant memories, all retained when switched off. 1,500 hour lithium battery. 93x24x55mm. Wallset. **ONLY £22.95**

LOW COST PROGRAMMABLE

CASIO FX-3600P 10 digit LC display. 55 scientific functions including INTEGRALS and REGRESSIONAL ANALYSIS. Up to 38 program steps – 2 programs. One independent memory, 6 constant memories, all retained when switched off. 1,500 hour lithium battery. 93x24x55mm. Wallset. **ONLY £22.95**

*Only on request, at time of ordering. RRP of 702P/602P versions, £9.95

DELIVERY NORMALLY BY RETURN OF POST.

Orders received by December 18th should be delivered in time for Christmas.

World's Most Versatile Alarm Chronograph Watch

AX-210

10 alternative displays; over 60 functions. LCD ANALOG display of time, plus: DIGITAL display of: Time (12 or 24 hour); Calendar; Full month calendar (this month and next month); Dual time (12 or 24 hour); Alarm time; Countdown alarm timer with memory function; Professional 1/100 second stopwatch with laps, etc. Hourly time signal. Alarm – electronic buzzer or 3 selectable melodies. Rapid forward/backward setting. 9.4x35.4x36mm.

(RRP £34.95) **ONLY £29.95**



CASIO'S NEW JOGGING WATCH

J-100 PACE RUNNER

Sets the pace for 1982

Displays hours, minutes and seconds (12 or 24 hours system); day and date. Auto calendar; calculator; professional 1/100 second stopwatch measuring net, laps and 1st and 2nd place times; **Pacer mode.** Can be used as a metronome to pace your running, or any other event. Input data: Length of stride. Pacer signals, from 394 pps per minute to 63 pps per minute. Output data: Elapsed time, up to 24 hours. Distance covered, number of strides, and speed.

(RRP £22.95) **ONLY £19.95**

100 METRE WATER RESISTANT 50M W/R



CASIO W-100
Resin case and strap

£19.95



CASIO W-150C
S/Steel case resin strap

£21.95



CASIO W-150B
All S/Steel

£24.95



CASIO W-51
All S/Steel

£22.95

Time and auto calendar. Alarm, hourly chimes, countdown alarm timer with repeat memory function, professional 1/100 second stopwatch. Time is always on display, regardless of display mode.

THESE SPACE INVADERS WILL ALARM YOU

Casio's most amazing watches ever.

CA-90 (left)

RRP £22.95

£19.95

Black resin case/strap.

CA-901 (right)

RRP £34.95

£29.95

Chrome plated case, S/S bracelet.

Time and auto calendar, calculator, alarm, hourly chimes, stopwatch, dual time, DIGITAL SPACE INVADER GAME.



LATEST PRODUCTS

AA-85 Restyled AA-81. Analog/digital alarm chronograph. **£29.95**
LC-950 A New metric conversion calculator with a double display. **£16.95**
BC-13 Calculator with built-in boxing game. **£16.95**
FX-82 More powerful version of the FX-81. **£12.95**

SHORT FORM CATALOGUE of latest calculators, key-boards and watches available on request. 14p stamp appreciated.

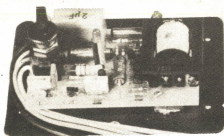
PRICE includes VAT and P&P. Send your company order, cheque, PO or phone your Access or Barclaycard.

TEMPUS

LEADING CASIO SPECIALISTS
Dept. EE,
164/167 East Road, Cambridge CB1 1DB
Telephone: 0223 212866



ELECTRONIC IGNITION KIT



TOTAL ENERGY DISCHARGE electronic ignition gives all the well known advantages of the best capacitive discharge systems.

PEAK PERFORMANCE — higher output voltage under all conditions.

IMPROVED ECONOMY — no loss of ignition performance between services.

FIRES FOULED SPARK PLUGS no other system can better the capacitive discharge system's ability to fire fouled plugs.

ACCURATE TIMING — prevents contact wear and arcing by reducing load to a few volts and a fraction of an amp.

SMOOTH PERFORMANCE — immune to contact bounce and similar effects which can cause loss of power and roughness.

PLUS

SUPER POWER SPARK — 3% times the energy of ordinary capacitive systems — 3% times the power of inductive systems.

OPTIMUM SPARK DURATION 3 times the duration of ordinary capacitive systems — essential for use on modern cars with weak fuel mixtures.

BETTER STARTING — full spark power even with low battery.

CORRECT SPARK POLARITY unlike most ordinary C.D. systems the correct output polarity is maintained to avoid increased stress on the H.T. system and operate all voltage triggered tachometers.

L.E.D. STATIC TIMING LIGHT for accurate setting of the engine's most important adjustment.

LOW RADIO INTERFERENCE fully suppressed supply and absence of inverter 'spikes' on the output reduces interference to a minimal level.

DESIGNED IN RELIABILITY an inherently more reliable circuit combined with top quality components — plus the 'ultimate insurance' of a changeover switch to revert instantly back to standard ignition.

IN KIT FORM

It provides a top performance electronic ignition system at less than half the price of competing ready-built systems. The kit includes everything needed, even a length of solder and a tiny tube of heatshrink compound. Detailed easy-to-follow instructions, complete with circuit diagram, are provided — all you need is a small soldering iron and a few basic tools.

AS REVIEWED IN **ELECTRONICS TODAY MAGAZINE**

JUNE '81 ISSUE

Quote "the kit is very impressive"

"well written instructions and a good performance".

"Excellent value for money. Highly recommended".

FITS ALL VEHICLES, 6 or 12 volt, with or without ballast
NEGATIVE EARTH ONLY

OPERATES ALL VOLTAGE IMPULSE TACHOMETERS
Some older current impulse types (Smiths pre '74) require an adaptor — PRICE £2.95

STANDARD CAR KIT £14.85 PLUS £1
TWIN OUTPUT KIT £22.94 U.K. P.&P.

For MOTOR CYCLES and CARS with twin ignition systems

Prices include V.A.T.



ELECTRONIZE DESIGN

Magnus Road, Wilnecote,

Tamworth. B77 5BV

Phone 0827-281000



DIMENSIONS: Length 12.5 cm
Width 8.9 cm
Height 4.3 cm
Lead length 100.0 cm

TECHNICAL DETAILS

The basic function of a spark ignition system is often lost among claims for longer 'burn times' and other marketing fantasies. It is only necessary to consider that, even in a small engine, the burning fuel releases over 5000 times the energy of the spark, to realise that the spark is only a trigger for the combustion. Once the fuel is ignited the spark is insignificant and has no effect on the rate of combustion. The essential function of the spark is to start that combustion as quickly as possible and that requires a high power spark.

The traditional capacitive discharge system has this high power spark but, due to it's very short spark duration and consequential low spark energy, is incompatible with the weak air/fuel mixtures used in modern cars. Because of this most manufacturers have abandoned capacitive discharge in favour of the cheaper inductive system with it's low power but very long duration spark which guarantees that sooner or later the fuel will ignite. However, a spark lasting 2000µs at 2000 rev/min. spans 24 degrees and 'later' could mean the actual fuel ignition point is retarded by this amount.

The solution is a very high power, medium duration, spark generated by the **TOTAL ENERGY DISCHARGE** system. This gives ignition of the weakest mixtures with the minimum of timing delay and variation for a smooth efficient engine.

SUPER POWER DISCHARGE CIRCUIT A brand new technique prevents energy being reflected back to the storage capacitor, giving 3% times the spark energy and 3 times the spark duration of ordinary C.D. systems, generating a spark powerful enough to cause rapid ignition of even the weakest fuel mixtures without the ignition delay associated with lower power 'long burn' inductive systems.

HIGH EFFICIENCY INVERTER A high power, regulated inverter provides a 370 volt energy source — powerful enough to store twice the energy of other designs and regulated to provide sufficient output even with a battery down to 4 volts.

PRECISION SPARK TIMING CIRCUIT This circuit removes all unwanted signals caused by contact volt drop, contact shuffe, contact bounce, and external transients which, in many designs, can cause timing errors or damaging un-timed sparks. Only at the correct and precise contact opening is a spark produced. Contact wear is almost eliminated by reducing the contact breaker current to a low level — just sufficient to keep the contacts clean.

TYPICAL SPECIFICATION

	TOTAL ENERGY DISCHARGE	ORDINARY CAPACITIVE DISCHARGE
SPARK POWER (PEAK)	140 W	90 W
SPARK ENERGY (STORED ENERGY)	36 mJ	10 mJ
SPARK DURATION	135 µs	65 µs
OUTPUT VOLTAGE (LOAD 50pF EQUIVALENT TO CLEAN PLUGS)	500 µs	160 µs
OUTPUT VOLTAGE (LOAD 50pF + 500 KΩ EQUIVALENT TO DIRTY PLUGS)	38 KV	26 KV
VOLTAGE RISE TIME TO 20 KV (Load 50pF)	26 KV	17 KV
	25 µs	30 µs

TOTAL ENERGY DISCHARGE should not be confused with low power inductive systems or hybrid so called reactive systems.

Goods normally despatched within 7 days

Wheel of Fortune
Simple P.H. Meter
LED Sand Glass
Morse Practice Oscillator
Door Alarm
CMOS Metronome
Xenon Strobe Lamp
Combination Lock
Electronic Multimeter
*Tremolo Unit
Loop Aerial Crystal Set
Darkroom Timer
Tape Auto Start
Audio Test Set
Soil Moisture Indicator
Phone Bell Repeater or Baby Alarm
Guitar Headphone Amplifier
Lights Reminder or Ignition Locator
Intercom
Digital Rule
Freezer Alarm
LED Dice
Mini Siren
Modulated Tone Doorbell
Bench Power Supply
Car Actuated Driveway Light
3 Channel Stereo Mixer
Signal Tracer
Niced Battery Charger
Auto Slide Charge
Ice Alarm
Phaser Sound Effects
Mini I.C. Radio
Sound to Light
Guitar Practice Amplifier
Transistor Tester
Soil Moisture Monitor
Audio Effects Unit
Phone Call Charge Jigger
Darkroom Controller
Bicycle Alarm
TTL Power Supply Unit
TTL Logic Probe
Bedside Radio
Signal Tracer
Autotune
A.F. Signal Generator
Auto Phase
Lights Warning System
Autofade
Cable and Pipe Locator
Micro Music Box
Simple Short Wave Receiver
Morse Practice Oscillator
Slide/Tape Synchroniser
Burglar Alarm
Baby Alarm
Chaser Light
Simple Transistor Tester
Varicap MW Radio
Electronic Tuning Fork
Warbling Timer
Electronic Canary
Tremolo Unit
One Transistor Radio MW/LW
Micro Chime
Lights Reminder for Car
Fuzz Box
Sound to Light
Weird Sounds Effect Generator

ZB164	Aug. 81	£27.50
ZB165	Aug. 81	£22.00
ZB162	Aug. 81	£5.00
ZB163	Aug. 81	£10.95
ZB166	Aug. 81	£6.00
ZB167	Aug. 81	£6.25
ZB161	July 81	£18.50
ZB160	July 81	£13.75
ZB159	July 81	£32.50
ZB157	June 81	£8.25
ZB158	June 81	£5.25
ZB155	June 81	£4.00
ZB156	June 81	£10.25
ZB152	May 81	£46.00
ZB154	May 81	£3.95
ZB153	May 81	£5.25
ZB151	May 81	£4.00
ZB150	May 81	£5.20
ZB149	April 81	£19.25
ZB148	April 81	£28.00
ZB147	April 81	£11.75
ZB146	March 81	£7.50
ZB145	March 81	£7.25
ZB144	March 81	£6.25
ZB143	March 81	£48.50
ZB142	March 81	£22.00
ZB141	Feb. 81	£16.25
ZB140	Feb. 81	£7.50
ZB139	Feb. 81	£12.00
ZB138	Jan. 81	£9.00
ZB137	Jan. 81	£7.25
ZB136	Jan. 81	£23.30
ZB126	Nov. 80	£10.35
ZB127	Nov. 80	£19.00
ZB128	Nov. 80	£16.85
ZB131	Nov. 80	£9.00
ZB132	Nov. 80	£12.25
ZB122	Oct. 80	£12.25
ZB121	Oct. 80	£6.00
ZB123	Oct. 80	£18.25
ZB124	Oct. 80	£9.25
ZB178	Sept. 80	£9.50
ZB176	Sept. 80	£3.75
ZB174	Sept. 80	£14.75
ZB80	July 80	£5.50
ZB83	July 80	£19.75
ZB84	July 80	£20.50
ZB86	July 80	£19.75
ZB83	May 80	£4.00
ZB86	May 80	£10.25
ZB84	March 80	£4.00
ZB85	Feb. 80	£17.50
ZB44	Feb. 80	£19.50
ZB43	Feb. 80	£6.00
ZB42	Feb. 80	£11.50
ZB51	Dec. 79	£5.50
ZB40	Nov. 79	£8.50
ZB4	Sept. 79	£18.50
ZB2	Sept. 79	£8.00
ZB1	Sept. 79	£8.50
ZB7	Aug. 79	£9.50
ZB5	Aug. 79	£6.30
ZB19	June 79	£5.00
ZB18	June 79	£10.50
ZB104	March 79	£7.25
ZB86	Feb. 79	£13.00
ZB32	Jan. 79	£5.00
ZB106	Dec. 78	£6.75
ZB112	Sept. 78	£7.00
ZB113	March 78	£6.00

TEACH-IN 82

All parts in stock.

List (1) £19.75
List (2) £10.50
Special Price List 1 and 2 £25.50

All Prices include Post & VAT
Callers Please Ring To Check Availability Of Kits

MAINS IONISER KIT ZD13

This negative ion generator gives you power to saturate your home or office with millions of refreshing ions. Without fans or moving parts it puts out a pleasant breeze. A pure flow of ions pours out like water from a fountain, filling your room. The result? Your air feels like fresh ocean air, pure crisp and wonderfully refreshing. All parts PCB and full instructions £12.95. A suitable case including front panel, neon switch, etc. Available at £9.95.

T. POWELL

ADVANCE WORKS,
44 WALLACE ROAD, LONDON N1
Tel: 01-226 1489
HOURS: Mon-Fri 9.5.30p.m. Sat 9.4.30p.m.



Minimum Telephone Orders £5.00
Minimum Mail Order £1.00

ELECTROVALUE

Popular components from "CATALOGUE 82", all prime stock, no seconds or fall-outs. Buy in quantity for even better values.

COMPONENT PACKS

CPI 100 ceramic capacitors from 1-8p to .1u. The selection is determined by the popularity of different values. £4.20.

Resistor Decade Packs 1/3W, 5% tolerance; each pack 100 items, selection determined by relative popularity of each value: Price £1.50 per pack.
RD1: 1R-8RT; RD2: 10R-82R; RD3: 100R-820R; RD4: 1K-82K; RD5: 10K-82K; RD6: 100K-82K; RD7: 1M-10-10M. £1.50 each Decade Pack.

SEMICONDUCTOR PACKS & Singles

LD30A red LED's (2-9mm): 25 for £1.58.
L51RD red LED's (5mm): 25 for £1.58.
1N4148 diodes: 25 for 68p.
1N4007 (1000V, 3A) diodes: 25 for £1.30.
1N5402 (200V, 3A) diodes: 25 for £2.80.
BC107/BC109: 25 for £2.98.
BC182/182L/183/183L/184/184L: 25 for £1.88.
BC212/212L/213/214/214L: 25 for £1.88.

Other popular items: unit prices
VOLTAGE REGULATORS
7805/12/15/24: 65p
7905/12/15/24: 85p
78L05/12/15/24: 32p
79L05/12/15/24: 67p
723 (14 pin): 36p
2N3819 22p
2N3055 70p

*SPECIAL OFFER
25 x 4116 (300MS) £20.00 only.

Please mention this journal when ordering or writing.

ELECTROVALUE LTD. DEPT. EEI/82 28, St. Jude's Road, Englefield Green, Egham, Surrey TW20 9NH. Phone Egham 39603 (STD 0784, London 87). Telex 244475.
Northern Branch (Personal Shoppers only) 680 Burnage Lane, Burnage, Manchester M19 1NA. Phone (061) 432 4945.

CATALOGUE

82

ESSENTIAL READING
FOR THE
Electronics Enthusiast
Computing Freak

Equipment
Manufacturer
PACKED WITH
INFORMATION ON
MORE THAN 6,000

STOCK ITEMS:
Active and Passive
Components Boxes,
Cases, Computer
Housing, Knobs, Pots,
Switches, Relays,
Everything from R's and
C's to Computing
Systems

ALL ITEMS BRAND
NEW AND
GUARANTEED

SPEEDY MAIL
ORDER SERVICE

No PIP charges on U.K.
C.W.D. orders over £25
Inc. V.A.T. (add 40p
handling charge if ordered
from abroad)

When ordering please
add 15% V.A.T. to total
value of all orders.

To obtain your copy of
CATALOGUE 82
Send 70p post fee
includes 70p voucher to
be reclaimed against
orders valued £10.00 or
over

BEFORE AND AFTER SCIENCE

HEY DUMMY! A weekly transfusion of New Musical Express is all it takes to make a REAL PERSON of you. With its scientifically-tested formula - truth and trivia, wit and gibberish - it's the modern music fan's complete life-support system. Every Thursday.



NEW

MUSICAL

EXPRESS

The paper for the almost human

Pic of Kraftwerk dummy by Anton Corbijn.

BI-PAK BARGAINS

"IRRESISTIBLE RESISTOR BARGAINS"

Pak No.	Qty*	Description	Price
SX10	400	Mixed 1/4 Watt Resistors	£1
SX11	400	Pre-formed 1/4 watt Carbon Resistors	£1
SX12	200	1/4 watt Carbon Resistors	£1
SX13	200	1/4 watt Carbon Resistors	£1
SX14	150	1/4 watt Resistors 22 ohm 2mm Mined	£1
SX15	100	1 and 2 watt Resistors 22 ohm 2mm Mined	£1

Paks SX12-15 contain a range of Carbon Film Resistors of assorted values from 22 ohms to 2.2 meg. Save pounds on these resistor packs and have a full range to cover your projects.

*Quantities approximate, count by weight.

"CAPABLE CAPACITOR PAKS"

Pak No.	Qty*	Description	Price
SX16	250	Capacitors Mixed Types	£1
SX17	200	Ceramic Capacitors Miniature Mixed	£1
SX18	100	Mixed Ceramics 1pL 5pL	£1
SX19	100	Mixed Ceramics 68pL 0.5mF	£1
SX20	100	Assorted Polyester/Polystyrene Capacitors	£1
SX21	60	Mixed C280 type capacitors metal foil	£1
SX22	100	Electronics, all sorts	£1
SX23	50	Quality Electrolytics	£1
SX24	20	Tantalum Beads, mixed	£1

*Quantities approximate, count by weight.

AUDIO PLUGS, SOCKETS AND ACCESSORIES

25	pieces of Audio Plugs, Sockets and Connectors to include DIN 180° 240° Inline 3-6 Pin Speakers, Phone, Jack, Stereo and Mono, etc. etc. Valued at well over £3 normal. Order No. SX25. Our Price £1.50 per pak. Guaranteed to save you money.	£1
SX26	3 Pcs. of 6 pin 240° DIN Plug and Chassis Sockets.	50p
SX27	1 Right Angle Stereo Jack Plug & 3mm plug matching metal chassis mounting socket.	30p
SX28	4 Phone plugs and 2 dual phone connectors.	20p
SX29	1 x 2.5mm Plug to 1.5mm Socket adaptor.	20p
SX30	1 x 3.5mm Plug to 2.5mm Socket adaptor.	20p
SX31	1 x 3.5mm Plug to Phone Socket adaptor.	20p



SX32	1 Standard Jack Plug to Phone Socket adaptor.	25p
SX33	1 Toggle Switch SPST Miniature. 125V 10A.	40p
SX34	1 Toggle Switch SPST Miniature. 240V 5A.	40p
SX35	1 Rocker Switch SPST Miniature. 240V 5A.	15p
SX36	1 Right Angle Mono Jack Plug.	£1
SX37	20 pieces. 1.2 & 4mm plugs and sockets (Banana). Matching covers and sizes.	£1
SX38	10 Assorted Switches. Toggle, Slide, Rocker. Push button.	£1
SX39	25 mixed cable clips and ties round grommets & plastic feed. Always sought by the project builder.	50p

TRIACS — PLASTIC

4 AMP — 400V — T0202 — TAG 136G.	
1 OFF	10 OFF
40p	£3.75
8 AMP 400V — T0220 — TAG 425	£30.00
60p	£5.75
	£27.50
	£50.00

Everyday Electronics

Teach-in '81
Kit 1 £15.85
Kit 2 £ 9.94

(Kits 1 & 2 combined
price £23.00)

All prices include P&H & postage.

SX40	250 Silicon Diodes—Switching like 1N4148 DO 35. All good—uncoded. Worth double our price 45V 75mA.	£1.25
SX41	250 Silicon Diodes—General Purpose. Like 0A200/202, BAX13/16. Uncoded. 30-100V 200mA DO 7.	£1.25

SX44	10 5A SCR's T064. 3 x 50v. 3 x 100v. 2 x 200v. 2 x 400v. Super value less than 1¢ price.	£1
------	--	----

SX45	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX46	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX47	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX48	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX49	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX50	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX51	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX52	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX53	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX54	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX55	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX56	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX57	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX58	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX59	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX60	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX61	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX62	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX63	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX64	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SX65	10 5A SCR's T066. 2 x 50v. 2 x 100v. 4 x 200v. 2 x 400v. All coded. Brand new, a genuine save.	£1
------	--	----

SEMICONDUCTORS FROM AROUND THE WORLD

100	A Collection of Transistors, Diodes, Rectifiers, Bridges, SCR's, Tracs. IC's both Logic and Linear plus Opto's all of which are current everyday usable devices.	100
------------	--	------------

Guaranteed Value over £10 at Normal Retail Price	
£4.00	

AND we guarantee your money back if you are not completely satisfied. FULL data etc included.	
Order No. SX57.	

BI-PAK'S OPTO BARGAIN OF THE YEAR!

Valued at over £10—Normal Retail—we offer you a pack of 25 Opto devices to include LED's Large and Small in Red, Green, Yellow and Clear. 7 Segment Displays both Common Cathode and Common Anode. PLUS bubble type display—like BL-33. Photo Transistors—similar to DP171 Photo Detectors—like MEL11-12. This whole pack of 25 devices will cost you just	
--	--

25	£4.00	25
-----------	--------------	-----------

AND we guarantee your money back if you are not completely satisfied. FULL data etc included.	
Order No. SX57.	

STILL MORE! SLIDER POTENTIOMETERS

SX66	50 metres PVC covered Hook up wire single and stranded. Mixed colours.	£1
SX67	25 Assorted TTL Gates 7400 Series: 7401-7460.	£1
SX68	10 Assorted Flip Flops and MSI TTL.	£1
SX69	20 Assorted Slider Potentiometers.	£1
SX70	25 Assorted Photo Transistors, Rotary, Dual, etc.	£1
SX71	40 Assorted Piezo-Sets Horn/Vent etc.	£1
SX72	10 Reed Switches — glass type 3 Reed Switches — with lever	£1

SX73	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX74	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX75	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX76	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX77	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX78	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX79	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX80	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX81	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX82	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX83	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX84	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX85	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

SX86	10 Reed Switches — glass type 3 Reed Switches — with lever	£1
------	--	----

£1 FREE PAK

Get a £1 FREE PAK. Orders over £10 excluding VAT. Choose £1 Pack FREE (ex 2 x 50p) add to your order and save even more money.	
--	--

This offer only applies to this advertisement	
---	--

Guarantee	
Satisfaction or your money back has always been BI-PAK's GUARANTEE and it still is. All these Sale items are in stock in quantity and we will despatch the same day as your order is received.	

IC SOCKETS The lowest price ever.

The more you buy the cheaper they come!	
Pin 10 off 10 off 100 off	
8 75p £3.00 £5	
14 80p £3.25 £5.50	
16 80p £3.25 £5.50	

VOLTAGE REGULATORS	
T0220	
Positive + Negative + (please state voltage required)	
7805 — 50p 7905 — 50p	
7812 — 50p 7912 — 50p	
7815 — 50p 7915 — 50p	
7824 — 50p 7924 — 50p	

Other types LM340 — 5 volt — 18 volt — 24 volt.	
T03 — 40p UAP23 — 18 pin DIL — 40p	

SX52	6 Black Heatinks will fit TO-3 and TO-220. Ready drilled. Half price value.	£1
------	---	----

SX53	1 Power finned Heatink. This heatink gives the greatest possible heat dissipation in the smallest space owing to its unique staggered fin design. pre drilled. TO-3 Size 45mm squares 20mm 2mm. 40p	£1
------	---	----

SX54	24 66uic. 35mm x 30mm x 12mm. 35p	£1
------	-----------------------------------	----

SX55	1 Heat Efficiency Power Finned Heatink. 90mm x 80mm x 35mm High. Drilled to take up to 4 x 1/8 inch screws.	£1
------	---	----

T03 3 devices	
£1.50 each	

SX38	100 Silicon NPN Transistors—all perfect. Coded mixed types with data and eqpt. sheet. No rejects. Real value.	£2.50
------	---	-------

SX39	100 Silicon PNP Transistors—all perfect. Coded mixed types with data and eqpt. sheet. No rejects. Fantastic value.	£2.50
------	--	-------

2ND055	The best known Power Transistors in the World — 2ND055 NPN 115W. Our BI-PAK Special Offer Price:	
18 off	50 off	100 off
£2.50	£16.00	£30.00

B0312	COMPLIMENTARY PNP POWER TRANSISTORS: TO 2N2065 — 103	
-------	--	--

Equivalent M21955 — B0312 — 103	
SPECIAL PRICE £8.70 each	

£10 £5.50	
-----------	--

Use your credit card. Ring us on 0486 3182 NOW and get your order faster. Goods normally sent 2nd Class Mail.	
---	--

Remember you must add VAT at 15% to your order Total. Postage add 50p per order Total order.	
--	--



CLASSIFIED

The prepaid rate for classified advertisements is 28 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £7.24 per single column centimetre (minimum 2.5cm). All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury

notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London SE1 9LS. (Telephone 01-261 5918).

When replying to Classified Advertisements please ensure:

- (A) That you have clearly stated your requirements.
- (B) That you have enclosed the right remittance.
- (C) That your name and address is written in block capitals, and
- (D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

50 AMP/100V DIODES £1.85 each, 100 amp Transformers, various voltages, from £12.00. List: R. Neville, Green Lane, Ellisfield, Nr Basingstoke, Hants.

ZZZHI! LEDs—green, yellow, amber, 5mm, 12p. Capacitors—100F, 40V, 11.5p. Plus 30p P&P. **STRAIGHTMAN ELECTRONICS**, 35 Melbourne Road, Ilford, Essex.

For Sale

NEW BACK ISSUES OF "EVERYDAY ELECTRONICS". Available 85p each Post Free, cheque or uncashed PO returned if not in stock. **BELL'S TELEVISION SERVICES**, 190 Kings Road, Harrogate, Yorkshire. Tel: (0423) 55885.

SECONDHAND ELECTRONIC TEST equipment including oscilloscopes, generators, psu's, NORFAB PLANT AND MACHINERY. Telephone Potter Heigham (069-27) 721.

A WISE INVESTMENT. A full technical library contained within six books—on three thousand pages full of circuits and data. The ideal gift for the enthusiast. Offer open for 3 months only at £15.00. E.R. Books, West Haven, Marldon, Paignton, Devon TQ3 1ST.

Software

SIXTY-FIVE ZX81 PROGRAMS. Listing only £4.95, Barclaycard accepted. Includes many games, utility programs, home finance, maths, chequebook, plus more. Includes hints'n'tips, from SUSSEX SOFTWARE, Wallsend House, Pevensey Bay, E. Sussex.

ZX81 Temperature Sensors (single channel), £19.50, includes UK P&P. SAE leaflet: Cheshire Micro Design, 66 Close Lane, Alsager, Stoke on Trent.

Books and Publications

PARAPHYSICALS JOURNAL (Russian translations): psychotronic generators, Kirlianography, gravity lasers, telekinesis. Details: SAE 4 x 9in, Paralab, Downton, Wilts.

MUSIC MAKER. Typewriter keyboard replaces piano type. Amateur organ builders send £1.00 for your copy—post free—"QWERTONIC MUSICAL KEYBOARD" a new book by P. G. Roche, to 71 Elmfield Avenue, Teddington, Middlesex TW11 8BX.

Service Sheets

BELL'S TELEVISION SERVICE for service sheets on Radio, TV etc. £1.25 plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Rd. Harrogate, N. Yorkshire. Tel: 0423 55885.

Any single service sheet £1/L.S.A.E. Thousands different Repair/Service Manuals/Sheets in stock. Repair data your named T.V. £8-50 with circuits £8-50. S.A.E. Newsletter, Price Lists. Quotations.

AUSEE, 76 CHURCHES, LARKHALL, LANARKSHIRE (0698 883334).

Tuition

PAY AS YOU LEARN. Postal mathematics tuition. CONWAY, 23 St Luke's Close, Middletown, Wakefield.

Receivers and Components

300 SMALL COMPONENTS, transistors, diodes, £1.70. 71bs assorted components, £4-25. 100bs £5-75. 40 assorted 74 series ICs on panel, £1-70. 500 capacitors, £3-20. List 20p, refundable. Post 60p. Optional insurance 20p. J.W.B. RADIO, 2 Barnfield Crescent, Sale, Cheshire M33 1NL.

TURN YOUR SURPLUS capacitors, transistors etc., into cash. Contact Coles Harding & Co., 103 South Brink, Wisbech, Cambs. 0945 4188, Immediate settlement.

CASES, ABS with p.c.b. slots L&W, with aluminium recessed cover-panel to enhance your controls, 150x90x50mm £1-55. 196x113x60mm £2-05. 150x68x41mm £1-10. 83x54x28mm 80p. Cases pressed steel with aluminium base and panels, recessed and vented, 102x86x83mm £1-70. 150x61x103mm £2-55. 150x76x134mm £3-04. 184x70x160mm £4-08. D x H x W. 119in Rack System, brushed aluminium front panel with chrome handles, with vented rear case including adjustable height chassis, 1.425 x D250 x H140mm, assembled £23-50, flat pack £19-50. All orders plus VAT at 15 per cent+P&P 50p; orders under £5. Lists 20p. Industrial and Trade enquiries welcome. **RELAY-A-QUIP**, Moat Lodge, Stock Chase, Maldon CM9 7AA. (0621-58688) 24 hrs.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Everyday Electronics for insertions. I enclose Cheque/P.O. for £..... (Cheques and Postal Orders should be crossed Lloyds Bank Ltd. and made payable to Everyday Electronics)

NAME

ADDRESS

Company registered in England. Registered No. 53068. Registered Office: King's Reach Tower, Stamford Road, London SE1 9LS.

Send to: Classified Advertisement Manager

EVERYDAY ELECTRONICS
Classified Advertisements Dept., Room 2337,
King's Reach Tower, Stamford Road, London SE1 9LS.
Telephone 01-261 5918

Rate:
28p per word, minimum 12 words. Box No. 60p extra.

Miscellaneous

OSCILLOSCOPE repair and calibration. Quick service, competitive rates. W. I. R. Electronics, 01-367 6816.

BALLARD'S OF TUNBRIDGE WELLS have moved to 54 Grosvenor Road. No lists. SAE. All enquiries phone T/Wells 31803.

LEARN ELECTRONICS WITHOUT SOLDER

Build electronic circuits without solder on a Roden S-Dec.

This has built-in contacts and holes into which you plug your components. Suitable for all ages. Can be used time after time. Ideal gift for students or experimenters. Full instructions and 2 circuit diagrams with each S-Dec.

Send cheque or P.O. to:
Roden Products, Dept EE
High March, Dovenby,
Northants, NN11 4QE.

£3.85

plus 40p p. 40p. each



STORAGE CABINET

Sturdy metal cabinet. Size approx 12" x 10" x 6" containing 26 individual clear plastic drawers, approx 1 1/2" x 2" x 5 1/2". Ideal for small capacitors, resistors, terminals, etc. Only £11.50 inclusive post & package. Send P/O, cash, cheque to J. Ramplin, 14 Liffen, Stenlydelph, Tarnworth, Staffs B77 4JB.

ENAMELLED COPPER WIRE. 10 swg to 45 swg. S.A.E. for quotation by return, cheapest prices. 102 Farrwood Road, Manchester 20.

PRE-PACKED. Screws, washers, solder tags, studding. Send for price list. Al Sales (EE), PO Box 402, London SW6 6LU.

CENTURION BUGALAR ALARM equipment, send SAE for free list or a cheque/PO for £11.50 for our special offer of a full sized signwritten bell cover to: Centurion, Dept EE, 265 Wakefield Road, Huddersfield, W. Yorkshire. Access & Barclaycard. Telephone orders on 0484 35527.

EVERYDAY ELECTRONICS P.C.B.'s

Drilled 1.5mm Glassfibre Fry's Roller-Tinned

JULY 81	Combination lock £1.94
JULY 81	Xenon strobe lamp £2.75
AUG 81	Wheel of fortune set of two £3.69
SEP 81	Model train control £1.58
	CMOS diodes £1.13
NOV 81	Electronic Ignition £1.98

For full list and current pcb's send SAE. Pcb's also produced to customers own masters. Trade enquiries welcomed. Write for quote.

CWO Pizace. Postage. Add 35p postage and packing to complete order. Europe 72p.

PROTO DESIGN, 14 DOWNHAM RD, RAMSDEN HEATH, BILLERICA, ESSEX, CM11 1PU
Telephone 8285-1107/2

DIGITAL WATCH BATTERY REPLACEMENT KIT



This watches all require battery (power cell) replacement at regular intervals. This kit provides the means. We supply eyeglass, non-magnetic tweezers, watch screwdriver, case knife and screwback case opener. Also one doz. assort. push-pieces, full instructions and battery identification chart. We then supply replacement batteries — you fit them. Begin now. Send £2 for complete kit and get into a fast growing business. Prompt despatch.

BOLSTER INSTRUMENT CO. (EE33)
11 Percy Avenue, Ashford, Middx., TW15 2PB

DIGITAL WATCH BATTERIES any type £1.20 each. Send SAE or 15p with number or old battery to DISCLEC Y, 511 Fulbridge Road, Werrington, Peterborough.

CORDLESS TELEPHONES, make your own inexpensive units. Send £3.00 for simple easy to follow plans to J. F. ASHLEY, Birley Grange, Cottage Farm, Baslow Road, Cuthorpe, Derbyshire.

THE SCIENTIFIC WIRE COMPANY

PO Box 30, London E4. 91 531 1968.

ENAMELLED COPPER WIRE

SWG	1lb	5oz	4oz	2oz
8 to 28	2.75	1.50	0.90	0.60
30 to 34	3.20	1.80	0.90	0.70
36 to 38	3.40	2.00	1.10	0.80
40 to 43	4.75	2.80	2.00	1.42
44 to 47	5.80	3.40	2.50	2.00
48 to 49	15.95	9.50	6.35	3.80

SILVER PLATED COPPER WIRE

14 to 30	6.50	3.75	2.20	1.40
----------	------	------	------	------

TINNED COPPER WIRE

14 to 30	3.85	2.38	1.34	0.90
----------	------	------	------	------

Prices incl. P.A.P vat. Orders under £2 add 90p. SAE for List of Copper/Resistance wire. Dealer enquiries welcome.

Registered Office 22 Coningsby Gardens.

Educational

COURSES—RADIO AMATEURS EXAMINATION. City and Guilds. Pass this important examination and obtain your licence, with an RRC Home Study Course. For details of this and other courses (GCE, professional examinations, etc) write or phone—The Rapid Results College Dept JR1, Tuition House, London SW19 4DS. Tel: 01-947 7272 (9 a.m.-5 p.m.) or use our 24hr Recordcall Service: 01-946 1102 quoting Dept JR1.

INDEX TO ADVERTISERS

Absonglen	53	E.D.A.	10	Phonosonics	4
Airwaves	4	Electroni-Kit	2	Pops Components	64
Alcon	8	Electronize Design	67	Powell T.	68
Ambit	6	Electrovalue	68		
Amtron	66			Radio Component Specialists	72
Audio Electronics	Cover ii	Greenweld	4	Radio TV Components	59
				Rapid Electronics	5
Bi-Pak	69	Home Radio	6	Science of Cambridge	60, 61
Bib Audio	55			Selray Book	64
BK Electronics	Cover iii	Intertext (ICS)	2	Silica Shop	7
B.N.R.E.S.	56			Silicon Speech Systems	66
Bull J.	63	Litesold	64	Tempus	65
				Titan Transformers	64
CHJ Supplies	6	Magenta Electronics	8, 9	T.K. Electronics	62
Chordgate	72	Maplin Electronic Supplies Ltd.	Cover iv	Watford Electronics	3
Cricklewood Electronics	66			Webb Electronics	62
				West London Direct Supplies	72
Dziubas M.	6	NME	68	Wilmslow Audio	2

any information covered by any of these, or included as a part of any presentation or information, directly or indirectly related to this document.



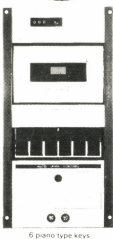
APPROVED
thondor
STOCKIST

B.K. ELECTRONICS

A SOUND CHOICE

APPROVED
thondor
STOCKIST

★ PROMPT DELIVERY ★ PRICES INCLUDE V.A.T. ★ AMPLE STOCKS
A PERSONAL SERVICE FROM A SMALL EXPANDING COMPANY



STEREO CASSETTE TAPE DECK MODULE

Comprising of a top panel and tape mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested.

Features: Three digit tape counter. Auto-stop. Six piano type keys: record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. **Input Sensitivity:** 100mV to 2V **Input Impedance:** 68K. **Output level:** 400mV to both left and right hand channels. **Output Impedance:** 10K. **Signal to noise ratio:** 45dB. **Wow and flutter:** 0.1%. **Power Supply requirements:** 18V DC at 300mA. **Connections:** The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). **Dimensions:** Top panel 5 1/2" x 11 1/2". Clearance required under top panel 2 1/4". Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish. **Price £26.70 + £2.50 postage and packing.** Supplementary parts for 18V D.C. power supply, transformer, bridge rectifier and smoothing capacitor) £3.

6 piano type keys

NEW RANGE QUALITY POWER LOUD-SPEAKERS

(15", 12" and 8") and 8"). These loudspeakers are ideal for both hi-fi and disco applications. Both the 12" and 15" units have heavy duty die-cast chassis and aluminium centre domes. All three units have white speaker cones and are fitted with attractive cast aluminium (ground finish) facing escutcheons. **Specification and Price:**—

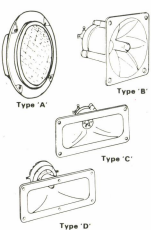
15" 100 watt R.M.S. Impedance 8 ohm, 50 oz. magnet, 2" aluminium voice coil. Resonant Frequency 20Hz. Frequency Response to 2.5KHz. Sensitivity 95dB. **Price £32 each.** £2.50 Packing and Carriage each.

12" 100 watt R.M.S. Impedance 8 ohm, 50 oz. magnet, 2" aluminium voice coil. Resonant Frequency 25Hz. Frequency Response to 4KHz. Sensitivity 95dB. **Price £23.70 each.** £2.50 Packing and Carriage each.

8" 50 watt R.M.S. Impedance 8 ohm, 20 oz. magnet, 1" aluminium voice coil. Resonant Frequency 40Hz. Frequency Response to 6KHz. Sensitivity 92dB. Also available with black cone and black protective grill. **Price £8.90 each.** £1.25 Packing and Carriage each.

PIEZO ELECTRIC TWEETERS — MOTOROLA

Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). **FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.**



Type 'A' 3in round with removable wire mesh. Ideal for bookshelf hi-fi speakers. **Price (Type 'A') £3.45 each.**

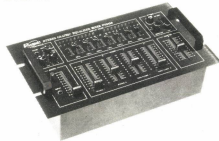
Type 'B' 3 1/2 inch square horn. For general purpose speakers disco and PA systems, etc. **Price £4.35 each.**

Type 'C' 2in x 5in wide dispersion horn. For hi-fi systems and quality disco etc. **Price £5.45 each.**

Type 'D' 2in x 6in wide dispersion horn. Frequency response extending down to mid-range (2000 c/s) suitable for hi-fi systems and quality disco. **Price £6.90 each.** Post and Packing, all types, 15p each (or SAE for Piezo leaflets).

Piezo Level Control Loudspeaker Terminals. Combines two spring-loaded loudspeaker terminals, one wound potentiometer and resistor network. All mounted on a smart brushed aluminium plate. Fits neatly through a 3" x 3" cut out on top of speaker cabinet. **Price £2.99 + 20p postage and packing.**

STEREO MIXER—GRAPHIC EQUALISER



SPECIFICATION: 5 Inputs:—
Microphone High 50K, Low 500ohm
Phono X2 50ohm
Tape/Tuner X2 50ohm
Frequency Response:—
Mic:— 10Hz—20K HZ
Phono X2 10Hz—20K HZ
Tape/Tuner X2 10Hz—20K HZ
Input Sensitivity:—
Mic High 3mV, Low 0.3mV
Phono X2 Mag. 3mV, Cry. 150mV
Output Impedance:—470 ohm
Tape/Tuner X2 150mV
Headphone Output:—0.25W at 8 ohms
Equaliser Control Frequencies:—60Hz, 150Hz, 400Hz, 1K HZ, 2.5K HZ, 5K HZ, 15K HZ.
Control Range:—12 db Boost or Cut.
Power:—220—240 AC
Dimensions:—300 x 200 x 120mm
Price:—£45.90 + £2.50 P & P.

5 Channel stereo disco mixer with built-in 7 band graphic equaliser. L.E.D. Vu Display. Monitored output. Fader mix and equaliser level button. Microphone talk over switch. Supplied complete and ready built. Ideal for incorporating into high quality disco public address consoles etc. or may be used free standing for hi-fi. (Inputs for dual turntables).

POWER AMPLIFIER MODULES

100 and 150 WATTS R.M.S. Power Amplifier Modules with integral toroidal transformer power supply and heat sink. Supplied as one complete built and tested unit. Can be fitted in minutes. Auxiliary stabilised supply and drive circuit incorporated to power an L.E.D. Vu meter available as an optional extra.

SPECIFICATION:
Max. output power 100 watts R.M.S. (OMP 100) 150 watts R.M.S. (OMP 150)
Loads: (Open and short circuit proof) 4—16 ohms
Frequency Response: 20Hz—25KHz ± 3dB
Sensitivity: for 100 watts 500mV at 10K 150 watts 500mV at 10K
T.H.D.:
Size: 360 x 115 x 80mm
Prices: OMP 100 £39.99 P & P £2.00
OMP 150 £39.99 P & P £2.00
V.u. Meter £4.90

Matching 3-way loudspeakers and crossover

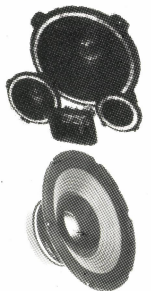
Build a quality 60 watt R.M.S. system.

- ★ 10" Woofer
- ★ 3" Tweeter
- ★ 5" Mid Range
- ★ 3-way crossover

Fitted with attractive cast aluminium fixing escutcheons and mesh protective grills which are removable enabling a unique choice of cabinet styling. Can be mounted directly on to baffle with or without conventional speaker fabrics. All three units have aluminium centre domes and rolled foam surround. Crossover combines spring-loaded loudspeaker terminals and recessed mounting panel. **Price £19.95 per kit + £2.50 postage and packing.** Available separately, prices on request.

12" 80 watt R.M.S. loudspeaker.

A superb general purpose twin cone loudspeaker. 50 oz. magnet, 2" aluminium voice coil. Rolled surround. Resonant frequency 25Hz. Frequency response to 13KHz. Sensitivity 95dB. Impedance 8ohm. Attractive blue cone with aluminium centre dome. **Price £16.49 ea. + £2.50 P & P.**



B.K. ELECTRONICS

DEPT E.E.

37 Whitehouse Meadows, Eastwood, Leigh-on-Sea, Essex S9 5TY

★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Mail order only. ★ All items packed (where applicable) in special energy absorbing PU foam. Callers welcome by prior appointment, please phone 0702-527572.



MAPLIN make it easy...



in SOUTHEND
284 London Road
Westcliff-on-Sea
Essex
Tel: (0702) 554000
(Closed Mondays)



in HAMMERSMITH
159-161 King Street
Hammersmith
London W6
Tel: 01-748 0926
(Closed Mondays)

For personal service visit one of our stores.
Our new store at Hammersmith is conveniently situated near the end of the M4 and the North and South Circular Roads.
There is excellent street parking on meters a few steps away and Hammersmith Underground Station is nearby. Call in and see us soon.



in our CATALOGUE

320 big pages packed with data and pictures of over 5,500 items

Over 100,000 copies sold already!
Don't miss out on your copy.

On sale now in all branches
WH Smith price £1.

In case of difficulty check the coupon below.

make it easy... with MAPLIN

The Maplin Matinee

Amazing value for only £299.95 plus £99.50 for cabinet if required (carriage extra)

Easy to build, send for our new book giving full construction details, order as XH55K price £2.50 inclusive.



MAPLIN ELECTRONIC SUPPLIES LTD.

by MAIL ORDER

A fast service
You can rely on

- * Same day service on in-stock lines
- * Very large percentage of our stock lines in stock
- * All prices include VAT
- * Large range of all the most useful components
- * First class reply paid envelope with every order
- * Quality components—no rejects—no re-marks
- * Competitive prices
- * Your money is safe with a reputable company

On price, service, stock, quality and security it makes sense now more than ever to make **maplin** your first choice for components every time!

Post this coupon now.

Please send me a copy of your 320 page catalogue. I enclose £1.25 (incl. 25p p&p). If I am not completely satisfied I may return the catalogue to you and have my money refunded. If you live outside the U.K. send £1.68 or 12 International Reply Coupons.

Name

Address